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The Domestic Beluga (*Delphinapterus leucas*) Fishery in the Mackenzie River Estuary, Northwest Territories, 1981-1986

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by

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ABSTRACT

Strong, J.T. 1990. The domestic beluga (Delphinapterus leucas) fishery in the Mackenzie River estuary, Northwest Territories, 1981-1986. Can. Data Rep. Fish. Aquat. Sci. 800: iv + 52 p.

Biological data and harvest information collected from the 1981-1986 domestic beluga in the Mackenzie River estuary are presented. The landed beluga reported by the contract monitors for each of six years were: 137, 107, 85, 134, 122 and 149. The average annual loss rate was 17 percent, with a range of 10-26 percent. Average annual mean lengths were: males 426 cm and females 369 cm. Sex ratios for each of the six years were 109, 267, 453, 694, 281 and 112 males per 100 females. The harvest is biased towards larger animals, and the greatest harvest occurs in the Kugmallit Bay area.

Key words: Western Arctic; white whales; harvest; morphometry; population dynamics.

RÉSUMÉ

Strong, J.T. 1990. The domestic beluga (Delphinapterus leucas) fishery in the Mackenzie River estuary, Northwest Territories, 1981-1986. Can. Data Rep. Fish. Aquat. Sci. 800: iv + 52 p.

On présente les données biologiques et l'information sur les prises relatives à la pêche intérieure au béluga dans l'estuaire du fleuve Mackenzie pour la période de 1981 à 1986. Le nombre de bélugas débarqués signalé par les surveillants à contrat pour chacune des six années a été le suivant : 137, 107, 85, 134, 122 et 149. Le taux des pertes annuelles moyennes a été de 17 p. cent, l'étendue étant de 10-26 p. cent. La moyenne des longueurs moyennes annuelles ont été de 426 cm pour les mâles et de 369 cm pour les femelles. Les sex-ratios pour les six années sont respectivement de 109, 267, 453, 694, 281 et 112 mâles pour 100 femelles. La récolte est biaisées en faveur des animaux de plus grande taille et la récolte la plus importante a eu lieu dans la région de la baie Kugmallit.

Mots-clés: Arctique occidental; béluga; récolte; morphométrie; dynamique des populations.

INTRODUCTION

The belugas (Delphinapterus leucas) summering in the Canadian Beaufort Sea (Fig. 1) are considered to be part of a population which is distributed through the Bering, Beaufort, Chukchi and Eastern Siberian seas, and Amundsen Gulf (Burns and Seaman 1986). The first recorded European contact with beluga in the Mackenzie Delta was July 3, 1789 when Alexander Mackenzie saw white whales on the west side of "Whale Island" (Daniells 1971), probably in what is locally called Niakunak Bay. The association between Delta residents and beluga predates European contact with North America; archaeological investigations (McGhee 1974) have revealed a well-developed beluga hunting culture in existence as early as the 14th century.

Fraker (1976) identified three "concentration areas" all located near major outflows of the Mackenzie River in Niakunak Bay, East Mackenzie Bay and Kugmallit Bay, where beluga gather annually from late June to August. The Mackenzie River estuary domestic beluga fishery, carried out by local Inuvialuit, is centered on these concentration areas and major hunting camps are location adjacent to them.

There are apparently no records of the western Arctic domestic beluga harvest prior to 1954, although recollected estimates such as those of Nuligak (1966) indicate that historical harvests may have been, at least occasionally, as high as 300 animals. Available catch statistics are reviewed by Smith and Taylor (1977) and Strong (1989).

This study was initiated to gather data on the harvest rate and to collect morphological data from landed specimens to be used in comparisons with other stocks at some later time.

MATERIALS AND METHODS

HARVEST DATA COLLECTION

Harvest information was collected annually by both observation and hunter interview. Two hunters from each community (Aklavik, Inuvik and Tuktoyaktuk) were hired on contract to monitor the beluga harvest of the camps in which they were seasonal residents. The Aklavik monitors recorded information from camps on West Mackenzie and Shallow Bays; the Inuvik monitors recorded information from Kendall Island, East Whitefish Station and camps in their vicinity; the Tuktoyaktuk monitors recorded information from hunts originating in the settlement and from Hendrickson Island (Fig. 1). Our data collection focussed on Kugmallit Bay, where most of the annual harvest occurs.

Data was recorded on either of two forms; one for use by contractors, the other by DFO staff (Appendix 1). Landed whales were assigned a sequential catalogue number, which identified location, species and year of harvest.

Various standard measurements (Norris 1961) were collected from each specimen. Measurements were most often recorded in imperial units then converted to metric and rounded. Total length was recorded as the straight line distance between nose and tail notch, parallel to the body surface. Half-girth was measured along the axillary and umbilical circumferences from dorsal ridge to mid-belly, and this value was doubled to obtain a full girth value. Other measurements including the number of teeth present were taken opportunistically (see Appendix 1 - DFO data sheet), but the completeness of the record depended on the progress of butchering, the time of observer arrival, and hunter cooperation.

Estimates of hunting losses from 1981-1986 are based on information provided by the contract observers. To derive our estimate, we assumed that all whales struck and lost died of their wounds (since we could not observe all hunting activity), and used the formula:

$$\frac{\text{\# Struck - \# Landed}}{\text{Total \# Struck}}$$

RESULTS

CURRENT HUNTING TECHNIQUES

Current hunting techniques differ little from those described by Slaney (1974), Fraker (1976, 1977) and Hunt (1979), although speedboats have largely replaced freighter canoes and some hunters favour fluorescent plastic buoys over 10 gallon gas drum floats. The 30/30 is still the most common rifle caliber used for beluga hunting (Table 1), as noted by Fraker and Fraker (1979).

Residents of Tuktoyaktuk generally hunt from the settlement, and take their catch home for processing. The catch may be towed whole or the muktuk (skin) and meat removed and transported. It is common for hunters from Tuktoyaktuk to hunt on weekends or when "off-shift" from their employment. Residents of Aklavik and Inuvik travel greater distances to the hunting area, generally hunt from and process their catch in a seasonal hunting camp and must transport their catch a considerable distance back to their homes. A few individuals from these settlements travel to the coast for short-term or weekend hunts and many of them utilize the established family camps. In 1981, four families from Holman participated in the whale hunt at Bird Camp in West Mackenzie Bay. Cooperation between hunting parties is still a feature of the hunt, but it is common for parties to hunt singly.

HARVEST

The landed catch of belugas from the four main hunting areas during the period 1981-1986 is presented in Table 2. The majority of beluga are harvested in July although successful hunts

as early as June 24 and as late as August 23 were reported during this study. Figure 2 shows the temporal distribution of the pooled reported harvest 1981-1986, annual data by hunting area and combined is provided in Appendix 2.

Discussions with long term beluga hunters suggest the number of individuals involved in the harvest has declined over time and that fewer families depend on the beluga for a winter food supply, even though the number of beluga harvested has remained fairly constant during recent times.

Harvest values reflect actual landings by residents in seasonal camps, and by most transient hunters. The harvest for Tukyoyaktuk may be under-reported due to the difficulty of keeping in contact with all active hunters. Six years of data (Table 2) show the number of beluga taken in Kugmallit Bay has consistantly exceeded the number taken from Niakunak Bay. The greatest number of beluga landed, approximately 45% of total, are taken by hunters from Tuktoyaktuk likely because the settlement is adjacent to a major hunting area.

Total annual loss rates between 1981 and 1986 ranged from 10 to 26% (Table 3), and average annual loss for the 5 year period is 17%. We believe the whale monitors accurately report the information they receive, but we are also aware that some hunters may not report landed or lost animals.

Most cartridges used today contain soft point bullets. Experienced hunters are of the opinion that fewer whales were lost when hard point ammunition was common and attribute a portion of the animals struck but lost to the inefficiency of soft-point ammunition compared to hard-point ammunition.

The sex composition of the harvest varied over the period of this study from 48% female in 1981 to 13% female in 1984 and back to 47% female in 1986 (Table 4). Hunters from Tuktoyaktuk took over 50% of all female beluga landed.

It is possible that some hunters report females as males and thus bias the harvest data. The male/female ratio reported by the contract whale observers from direct observation is correct, based on biological samples collected for other programs. Misrepresentation may have occured with whales reported through hunter interviews and not seen by the observer or DFO staff. The sex ratio of the observed harvest is similar to that of the reported harvest, suggesting that most hunters report the sex of their catch accurately.

BIOLOGY

Standard total lengths (Norris 1961) were collected from 400 male and 186 female beluga between 1981 and 1986. The total lengths reported in this study were collected by various individuals. Although minor inconsistancies among individuals are likely, we are confident that the lengths reported are suitable for distinguishing between length classes of beluga. This study includes all animals larger than 200 cm in calculations of mean total length. Table 5 provides the range, mean and standard deviation of those total lengths; annual data by area and combined is provided in Appendix 3. Figure 3 graphically compares the mean length, range and standard deviation of the total lengths of female and male belugas collected during the study. Figure 4 illustrates the annual combined total length data for 1981 to 1986, annual data is in Appendix 4. Table 5 provides the range, mean and standard deviation of axillary girths, fluke widths and flipper length and widths collected between 1983 and 1986.

During the period 1981-1986, 82 of 125 female beluga examined were in reproductive condition; of these, 43 were with a neonate and lactating or carrying a term foetus and lactating, five were carrying a non-term foetus but not lactating. No specific information was given for the remaining 26 reproductive females. Total lengths from reproductive female beluga all of which were longer than 320 cm, are provided in Table 6.

Lengths were collected from three neonates, six term foetuses and 11 non-term foetuses during this study. All lengths were measured as standard total lengths, and with the exception of a 22.5 cm non-term foetus collected August 2, were collected in July. Table 7 provides the total length and date of collection for each sample.

The mean length of non-term foetuses was 19.23 cm, of term foetuses 159.20 cm, and of neonates 198.91 cm. Ranges and standard deviation are provided in Table 8. The mean length of the combined sample of neonates and term foetuses is 172.44 cm.

Three non-term foetuses collected on July 13 were 12.7, 17.8 and 38.1 cm, and there is great variation in length over the sampling period for both categories of foetuses and for neonates. The data support an extended calving period for beluga lasting well into August.

The dental formula of 23 male and four female adult beluga was examined in the field (Table 9, Appendix 5). The formulae are similar, but not identical to those of other reseachers. Tomilin (1957) gives 9-9/8-8 or 10-10/9-9 as the most common dental formula for adult beluga in the Soviet Union and stated that only one of 69 animals examined had 11 pair of teeth in the upper jaw. The data show a variable number of teeth in each jaw, and in each quadrant. This has been attributed to tooth loss or incomplete eruption (Tomilin 1957; Kleinenberg et al. 1964). In total we found 14 different formulae among 27 whales with the number of teeth ranging from 28-40. Dental formulae 11-11/9-9, 10-10/10-10, and 10-10/9-9 occurred in three animals each; 8-8/8-8 and 7-7/7-7 were each found in two animals. All other combinations were found in one animal only.

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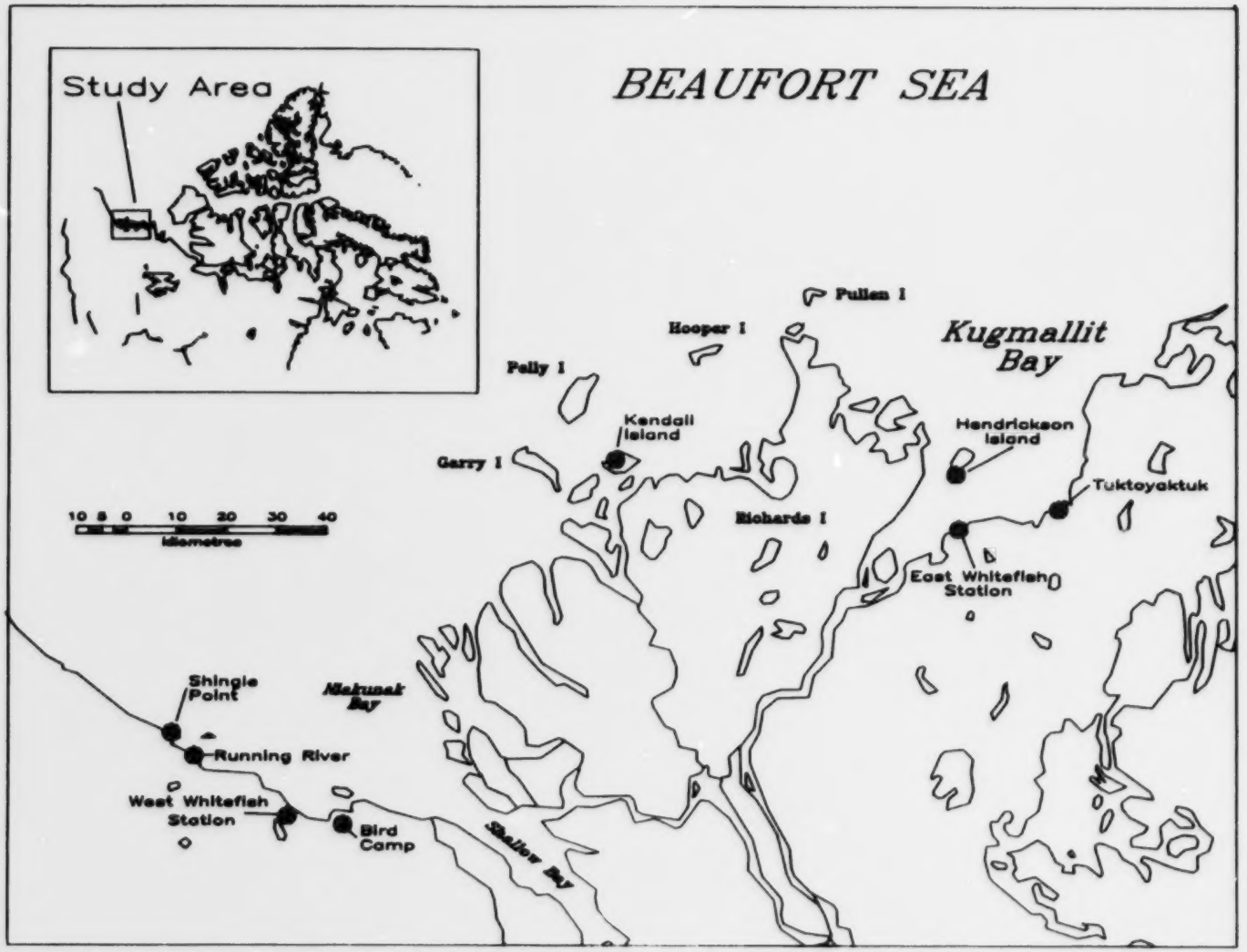


Fig. 1 Map of Mackenzie River esturary, Northwest Territories (showing hunting camps).

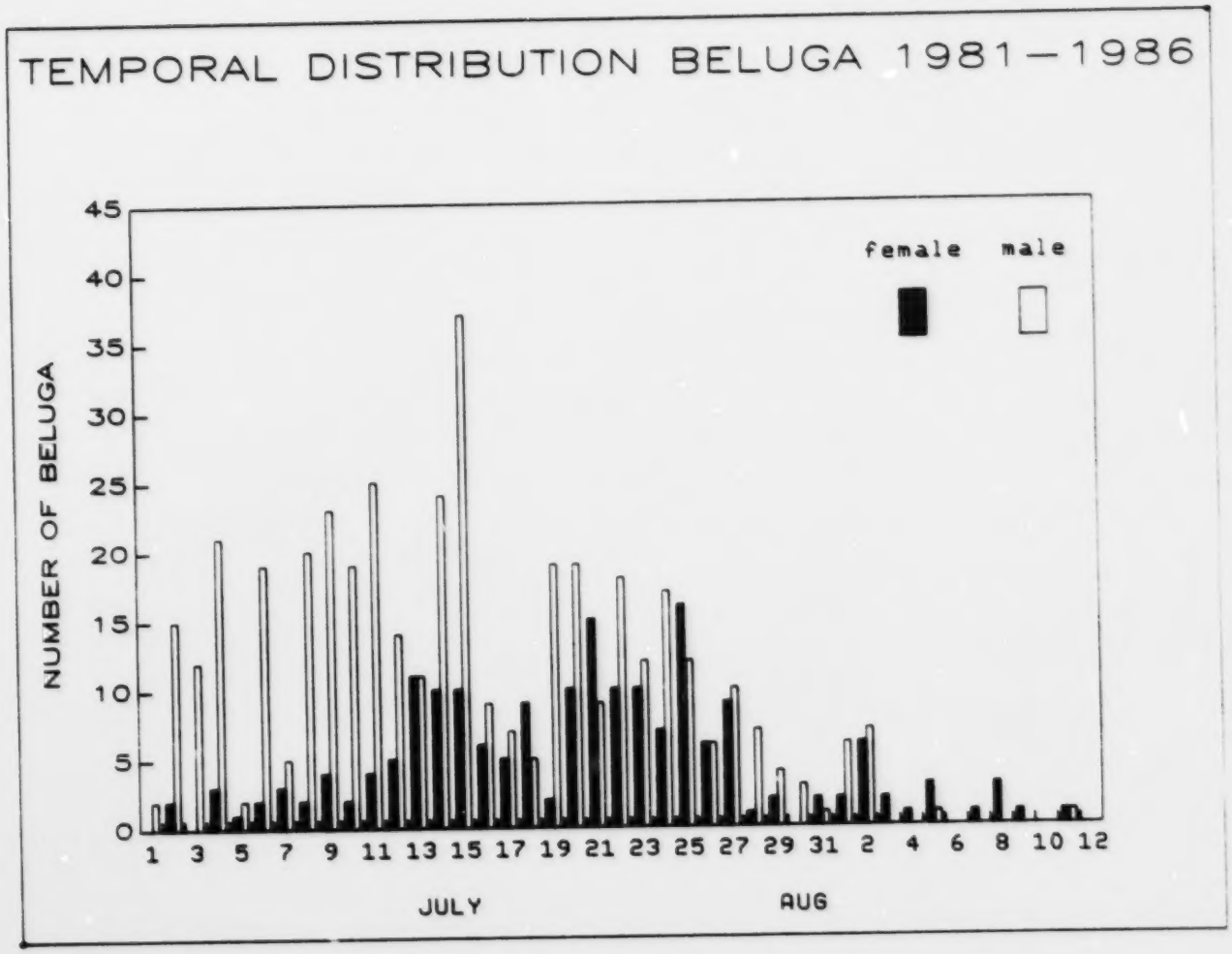


Fig. 2. Temporal distribution of the beluga whale harvest in the Mackenzie River estuary, 1981-1986.

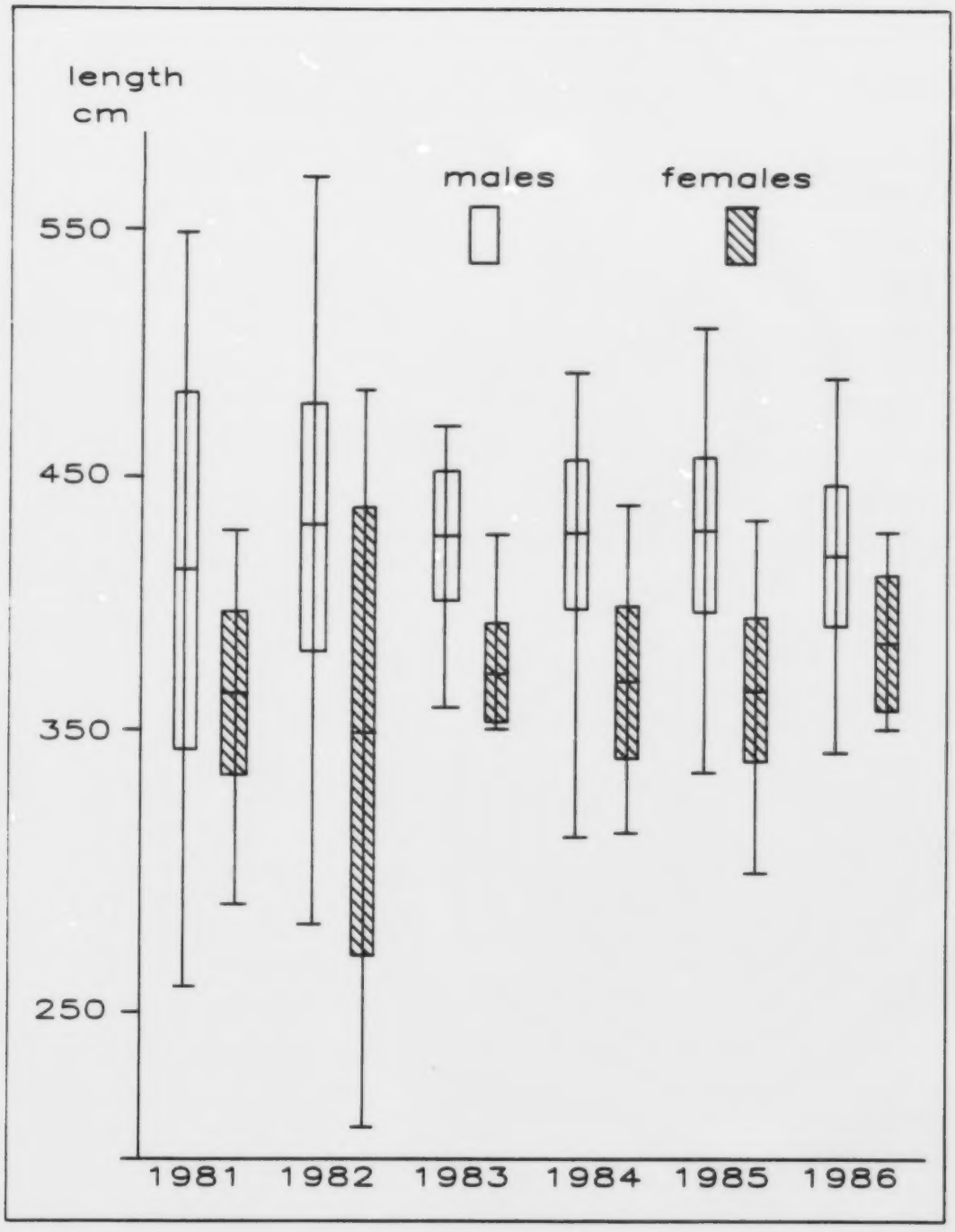


Fig. 3. comparison of mean length, range and standard deviation for male and female beluga whale harvested in the Mackenzie River estrary, 1981-1986.

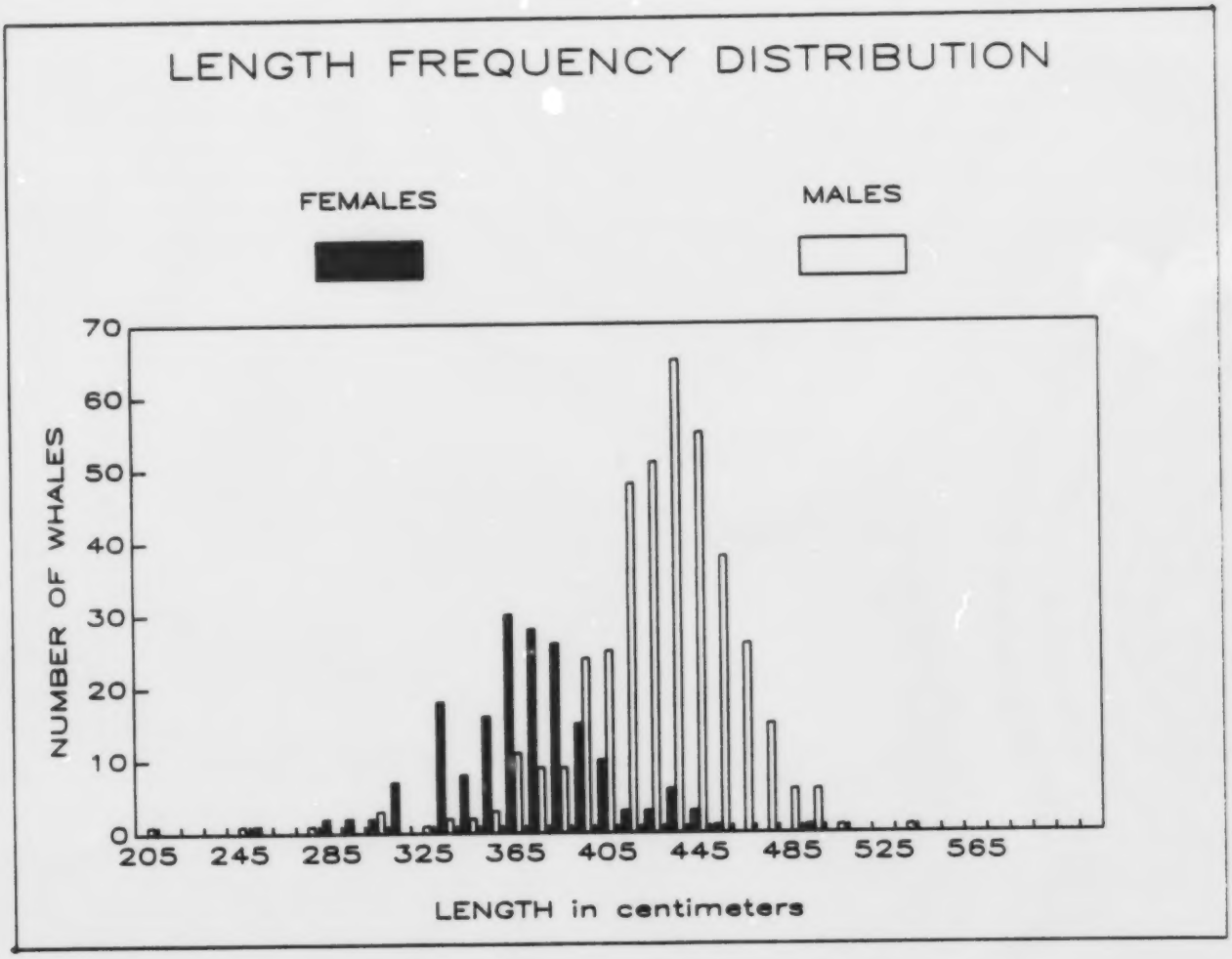


Fig. 4. Length frequencies of beluga whale harvested in the Mackenzie River estuary, 1981-1986.

Table 1. Cartridge use and shots fired during successful beluga hunts in the Mackenzie River Estuary. Data reported by hunters. Calibers ranked in order of use.

Caliber	Number of Hunts	Number of Shots/Landed Whale	
		Average	Range
30/30 Winchester	418	6	1-50
.270 Winchester	69	7	1-20
.243 Winchester	68	6	1-15
.303 British	44	6	1-40
30/06 Spring field	44	6	1-20
.308 Winchester	35	5	1-15
.300 Savage	17	6	1-14
6 mm Remington	10	9	3-10
.30 Remington	3	11	8-13
.250 Savage	2	4	3-4
444 Marlin	2	6	2-10
12 GA.	2	1	-
7 mm Remington Magnum	1	1	-
.357[1]	1	5	-
.300[1]	1	5	-
25/06 Winchester	1	1	-
25/35 Winchester	1	NR[2]	-

[1] no other information provided on data sheet and more than one cartridge possibility exists. .357 may be an error.

[2] NR = not recorded

Table 2. Numbers of beluga reported as struck/landed, by hunting area 1981-1986, from observer records.

Year		West Whitefish	Kendall Island	East Whitefish	Tuktoyaktuk	Total
1981	Struck	41	25	35	76	177
	Landed	40[1]	23	27	62	152
1982	Struck	28	28	27	44	127
	Landed	20	25	23	39	107
1983	Struck	16	28	15	43	102
	Landed	13	25	13	35	86
1984	Struck	21	31	37	67	156
	Landed	20	30	32	59	141
1985	Struck	15	35	28	67	149[2]
	Landed	12	25	21	59	121
1986	Struck	22	25	35	117	199[3]
	Landed	22	14	25	89	150
Totals	Struck	143	172	177	414	910
	Landed	127	142	141	343	757

[1]15 of the whales reported landed were utilized by Holman families.

[2]1985 Totals include 3 whales reported from Paulatuk and 1 whale reported from Coppermine which are not included in the hunting area totals.

[3]1986 Totals include 40 whales (20 landed) taken from Kugmallit Bay but not reported to monitors, and 6 whales taken in a net in the West Whitefish area which are not included in the struck total.

Table 3. Reported loss rates, (struck-landed/struck) from the Mackenzie River estuary beluga fishery 1981-1986.

Year	WWF	KI	EWF	TUK	Yearly Totals
1981	0.02	0.08	0.23	0.18	0.14
1982	0.23	0.11	0.15	0.11	0.16
1983	0.19	0.11	0.13	0.19	0.16
1984	0.05	0.03	0.14	0.12	0.10
1985	0.20	0.29	0.25	0.12	0.19
1986[1]	0.14	0.44	0.29	0.24	0.26
1981-1986 mean	0.13	0.17	0.20	0.17	0.17

[1] 1986 loss rates do not include 6 beluga taken in a net.

Table 4. Annual breakdown, by sex of Mackenzie Delta beluga whale harvest 1981-1986 and 1974-1981.

Year	Male	Female	% of Harvest Reported
1981	60 (52%)	55 (48%)	76
1982	72 (73%)	27 (27%)	93
1983	68 (82%)	15 (18%)	97
1984	111 (87%)	16 (13%)	90
1985	76 (74%)	27 (26%)	85
1986	64 (53%)	57 (47%)	81

Table 5. Range, mean and standard deviation of various measurements from beluga harvested in the Mackenzie River estuary 1981-1986. From observers record sheets.

		sex	n.	size range cm.	mean	s.d.
1981	Total Length					
		M	51	208 - 549	421.16	51.33
		F	53	152 - 429	361.32	43.53
1982	Total Length					
		M	69	274 - 505	430.75	48.62
		F	27	190 - 450	357.56	54.71
1983	Total Length					
		M	60	154 - 473	423.35	43.40
		F	15	353 - 452	378.53	28.43
	Axillary Girth					
		M	38	88 - 398	260.13	44.36
		F	9	200 - 254	225.44	18.85
	Fluke Width					
		M	20	36 - 117	97.35	17.77
		F	10	62 - 102	78.80	13.28
	Flipper Length					
		M	28	23 - 53	40.68	7.74
		F	9	30 - 46	36.67	5.12
	Flipper Width					
		M	27	12 - 48	33.63	7.89
		F	9	25 - 41	29.67	4.92
1984	Total Length					
		M	85	310 - 495	429.73	29.81
		F	15	310 - 442	371.00	31.30
	Axillary Girth					
		M	51	168 - 356	258.16	31.45
		F	12	183 - 264	219.33	21.92
	Fluke Width					
		M	29	79 - 117	100.21	9.91
		F	6	53 - 104	77.17	16.24
	Flipper Length					
		M	34	36 - 52	45.24	4.04
		F	8	38 - 46	41.00	2.83
	Flipper Width					
		M	33	20 - 37	31.67	4.06
		F	8	24 - 33	27.88	2.53

cont'd

Table 5. Continued

		Sex	n.	size range cm.	mean	s.d.
1985	Total Length	M	76	338 - 513	432.00	30.95
		F	26	295 - 434	366.69	28.25
	Axillary Girth	M	71	190 - 321	251.86	29.51
		F	22	178 - 244	203.68	17.74
	Fluke Width	M	70	71 - 121	100.91	10.75
		F	23	71 - 104	83.22	7.61
	Flipper Length	M	68	32 - 58	44.03	4.83
		F	21	36 - 46	39.71	2.99
	Flipper Width	M	68	27 - 40	32.91	3.04
		F	21	24 - 33	27.76	2.83
1986	Total Length	M	59	343 - 493	421.64	28.01
		F	50	320 - 457	378.48	28.14
	Axillary Girth	M	59	190 - 328	247.37	30.58
		F	44	137 - 259	210.48	26.17
	Fluke Width	M	56	84 - 127	100.94	9.13
		F	45	51 - 99	81.16	9.11
	Flipper Length	M	58	30 - 53	43.48	4.55
		F	46	30 - 48	38.63	3.93
	Flipper Width	M	58	23 - 51	32.98	4.71
		F	46	18 - 36	27.85	3.20

Table 6. Total lengths of female beluga known to be currently reproductive, Mackenzie River Delta 1981-1986.

Year	n	Range (cm)	Mean	S.D.
1981	27	320-419	374	21.90
1982	4	320-381	356	27.21
1983	8	356-383	368	9.91
1984	10	320-385	365	19.20
1985	12	333-434	363	18
1986	13	320-457	369	33
Total	49	320-457	364	21.44

Table 7. Total lengths (cm) and date of collection for foetuses and neonates collected in the Mackenzie River Estuary Beluga Fishery 1981-1986.

	July														August
Date	2	6	10	12	13	16	17	18	20	21	22	23	24	25	27	2
Non-Term		17.78		21.25	12.7 17.78 38.1		15.0	17.78		10.8				20.32	17.5	22.5
Term					165.10	172.72			154.5		120.0	190.5	152.4			
Neonate	197.95		208.28		190.50											

Table 9. Mean, range and standard deviation from total lengths of foetuses and neonates collected in the Mackenzie River Estuary Beluga Fishery 1981-1986.

	Category	n	Range (cm)	Mean	S.D.
1	Non-term Foetus	11	10.8-38.1	19.23	7.16
2	Term Foetus	6	120.0-190.50	159.20	23.67
3	Neonates	3	190.50-208.28	198.91	8.93
	2 & 3	9	120.0-208.28	172.44	27.65

Table 9. Range and average of the number of teeth recorded from beluga harvested in the Canadian Beaufort sea.

Upper Jaw		Lower Jaw	
number	23	number	23
range	13-20	range	12-20
average	17.6	average	16.5

Upper Left		Lower Left	
number	21	number	21
range	7-11	range	6-10
average	17.6	average	16.5

Upper Right		Lower Right	
number	21	number	21
range	6-11	range	6-10
average	17.6	average	16.5

OVERALL AVERAGES

	Upper	Lower
left	9	8
right	9	9

APPENDIX 1

Data Sheets

Government of Canada / Gouvernement du Canada
Fisheries and Oceans / Pêches et Océans

BELUGA WHALE STUDY - DAILY RECORD

NO: _____

FISH AND MARINE MAMMAL MANAGEMENT DIVISION

AREA: _____ DATE: _____

FIELD WORKER/MONITOR: _____

A. THE HUNT:

WEATHER: _____ SUNNY _____ CLOUDY _____ WINDY _____ RAIN

WATER: _____ RIPPLES (1-6 INCHES) _____ ROUGH (1-2 FEET)

_____ SMALL WAVES (½-1 FOOT) _____ STORM (OVER 2 FEET)

HUNTER NAME(S): _____

_____ COMMUNITY _____

TIME OUT OF CAMP _____ TIME RETURNED TO CAMP _____

DID SEE WHALES? _____ YES _____ NO IF YES, HOW MANY? _____

HOW MANY WHALES STRUCK (SHOT)? _____ HOW MANY WHALES LANDED? _____

HOW MANY WHALES WOUNDED, LOST OR SUNK? _____

CALIBRE OF RIFLE? _____ TOTAL NUMBER OF SHOTS FIRED? _____

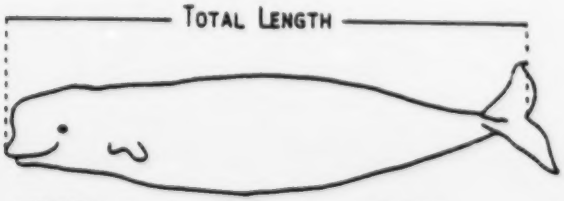
GENERAL COMMENTS: _____

_____

_____

B. SAMPLE INFORMATION:

"STRAIGHT LINE FROM TIP OF SNOUT TO NOTCH IN TAIL"



LENGTH: _____ FEET _____ INCHES

SEX: _____ MALE _____ FEMALE

COLOR:

_____ BROWN ___GREY OR BLUISH

_____ WHITE WITH GREY ON FLUKE AND FLIPPERS

_____ WHITE ___ YELLOW

STOMACH: ___ FULL ___ ½ FULL ___EMPTY

IF FOOD PRESENT: _____ MOSTLY FISH

_____ MOSTLY SHRIMP OTHER: _____

_____

IF FEMALE: WAS SHE WITH A NEWBORN CALF? _____ YES _____ NO

WAS SHE GIVING MILK? _____ YES _____ NO

WAS SHE PREGNANT? _____ YES _____ NO

IF PREGNANT, MEASURE LENGTH OF FETUS (UNBORN CALF). _____ FEET _____ INCHES

SAMPLES TAKEN:

_____ JAW (½ OF LOWER JAW WITH TEETH)

_____ TESTIS

_____ UTERUS AND OVARIES

_____ FETUS

_____ STOMACH CONTENTS

_____ OTHER: _____

NOTE: PLEASE INSURE THAT THE SAMPLE NUMBER ON THE SPECIMEN TAG IS THE SAME NUMBER AS SHOWN ON THE TOP RIGHT OF THIS PAGE.

Fisheries and Oceans / Pêches et Océans

MARINE MAMMAL MANAGEMENT
501 UNIVERSITY CRES.
WINNIPEG, MAN. R3T 2N6

Cetacean Data Sheet

SAMPLE NO. _____ (sec. no. yr. rec.) SEX _____ DATE _____ (yr. mo. day) SAMPLERS _____

SPECIES _____ Location _____ lat. _____ (deg. min. sec.) long. _____ (deg. min.)

Hunter(s) _____ Community _____ TIME AFTER DEATH _____ hrs.

Weather: wind _____ sky _____ water/ice _____

PIGMENTATION:

CAUSE OF DEATH
bullet entry and path

SCARS

TOTAL LENGTH	1	cm
FLUKE WIDTH	2	cm
GIRTH AT ARMPIT	3	cm
GIRTH AT NAVEL	4	cm
FLIPPER LENGTH		
anterior origin to tip	5	cm
axilla to tip	6	cm
maximum width	7	cm
TUSK		
exposed length	8	cm
total length		cm
basal circ.		cm
condition		

MILK amt: none/little/lots
(tick boxes)

lt. green	☐	thick	☐
dk. green	☐	thin	☐
yellow	☐	oily	☐
cream	☐	sticky	☐
white	☐	watery	☐
clear	☐	other	☐
opaque	☐		

STOMACH CONTENTS: description

AMOUNT

SAMPLES

snout or Tail		
to anus	11	cm
to mid-point of genital slit	12	cm
to navel	13	cm
to anterior origin of flipper	14	cm
to ear	15	cm
to eye	16	cm
to blowhole	17	cm
to angle of mouth	18	cm
depth of tail notch	19	cm
girth at anus	20	cm
girth at eye	21	cm
eye to ear (surface)		cm
eye to blowhole (surface)		cm
eye to angle of mouth (surface)		cm
blowhole width		cm

BLUBBER THICKNESS

	at armpit MUKTUK	BLUBBER
back		cm
side		cm
belly		cm
at navel		
back		cm
side		cm
belly		cm

FOETUS
if FULL TERM — sampled? yes/no
sample no. _____
if NON TERM
which horn? left/right
sex ♂ ♀
length _____ cm
weight _____ kg
placental wt. _____ kg

TESTIS left/right

weight		kg
length		cm
width		cm
height		cm
sperm?	no/little/lots	

MAMMARY GLAND left right
thickness _____ _____ cm
UTERINE CORNUA
diameter _____ _____ cm
CORPORA LUTEA
present? _____ _____

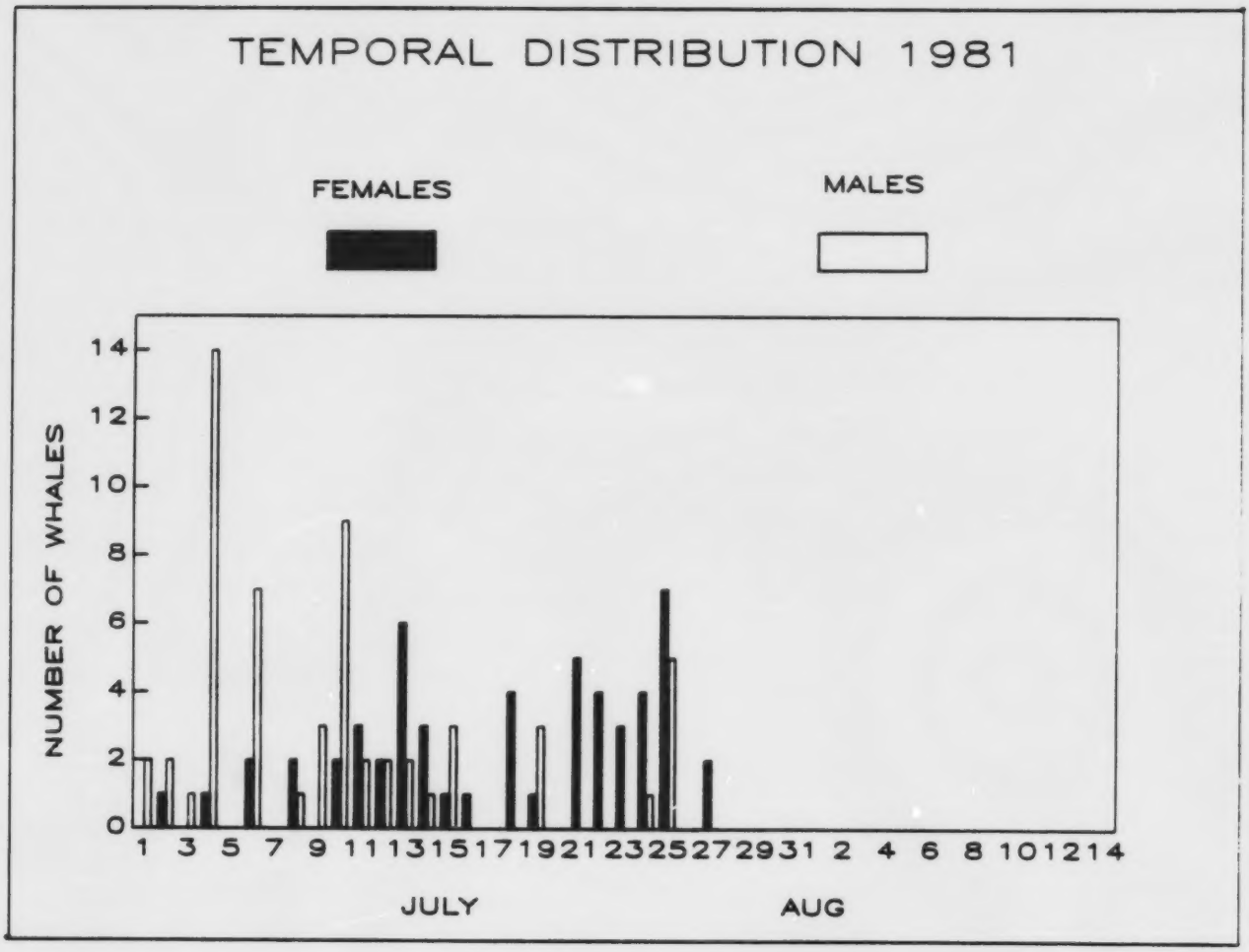
COMMENTS—

Photo — yes/no

Canada

APPENDIX 2

Temporal distribution of the beluga whale harvest in the Mackenzie River Estuary: Annually, by area and cumulative, 1981-1986.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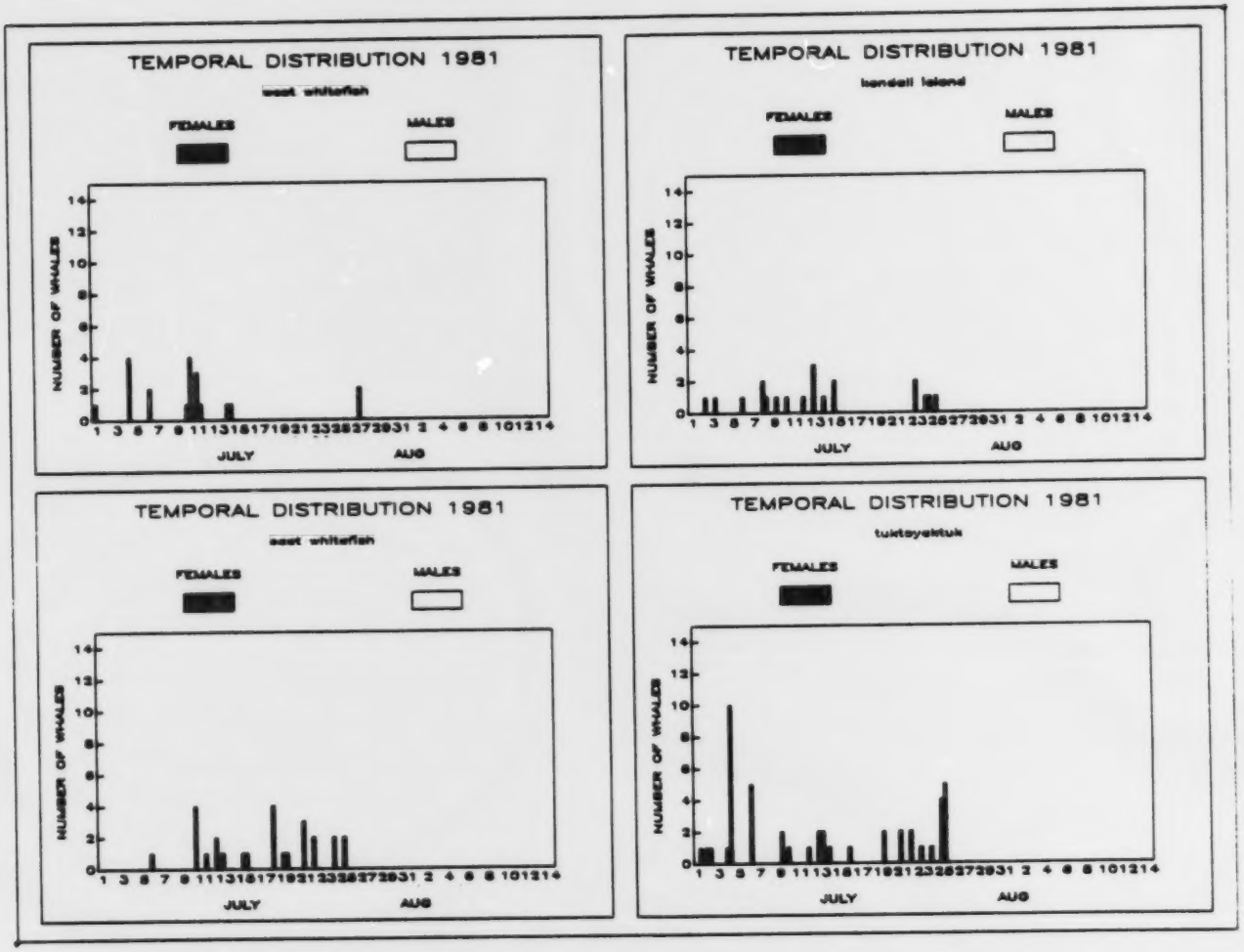
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TEMPORAL DISTRIBUTION 1981
east whitefish
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TEMPORAL DISTRIBUTION 1981
tuktoyaktuk
FEMALES
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NUMBER OF WHALES
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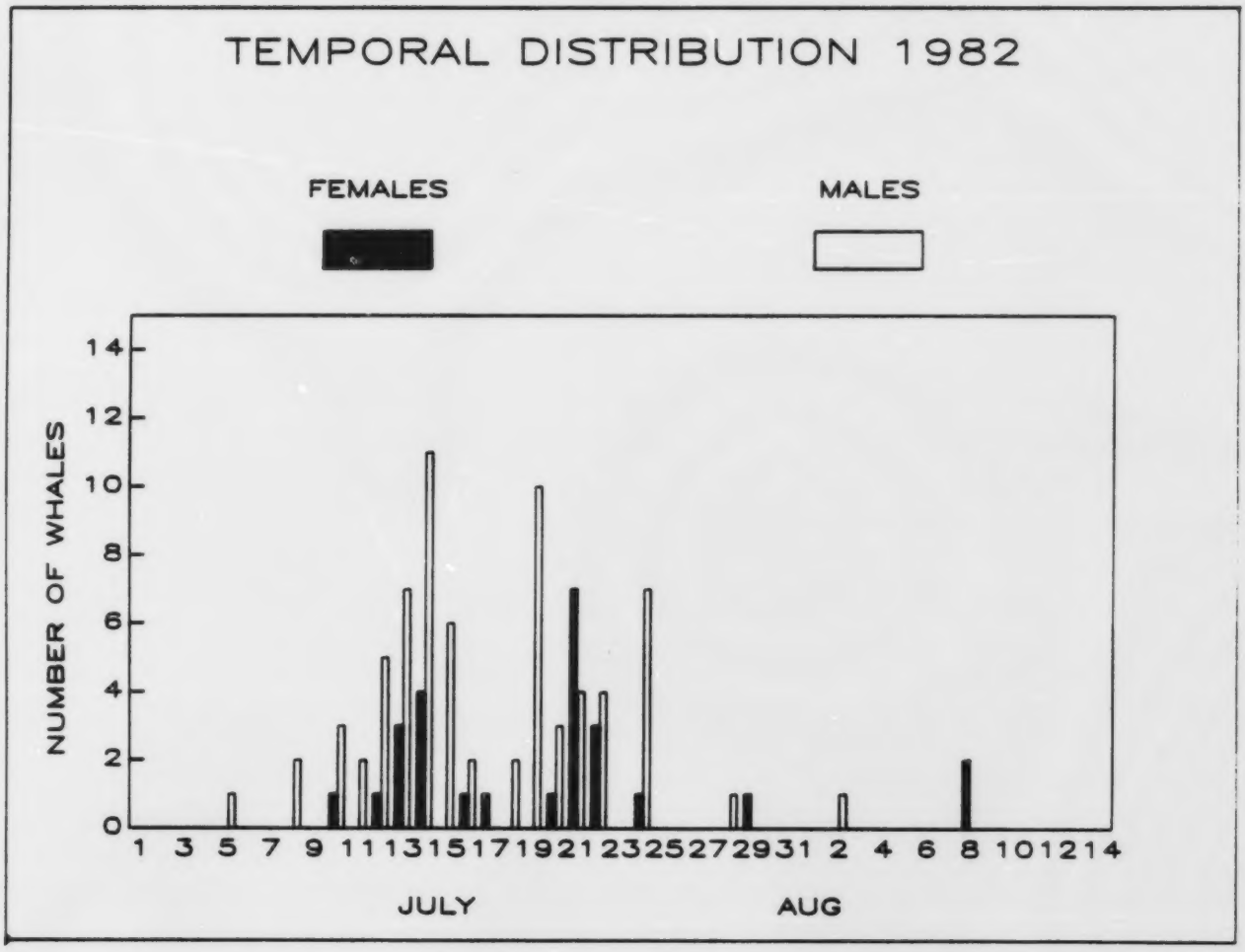
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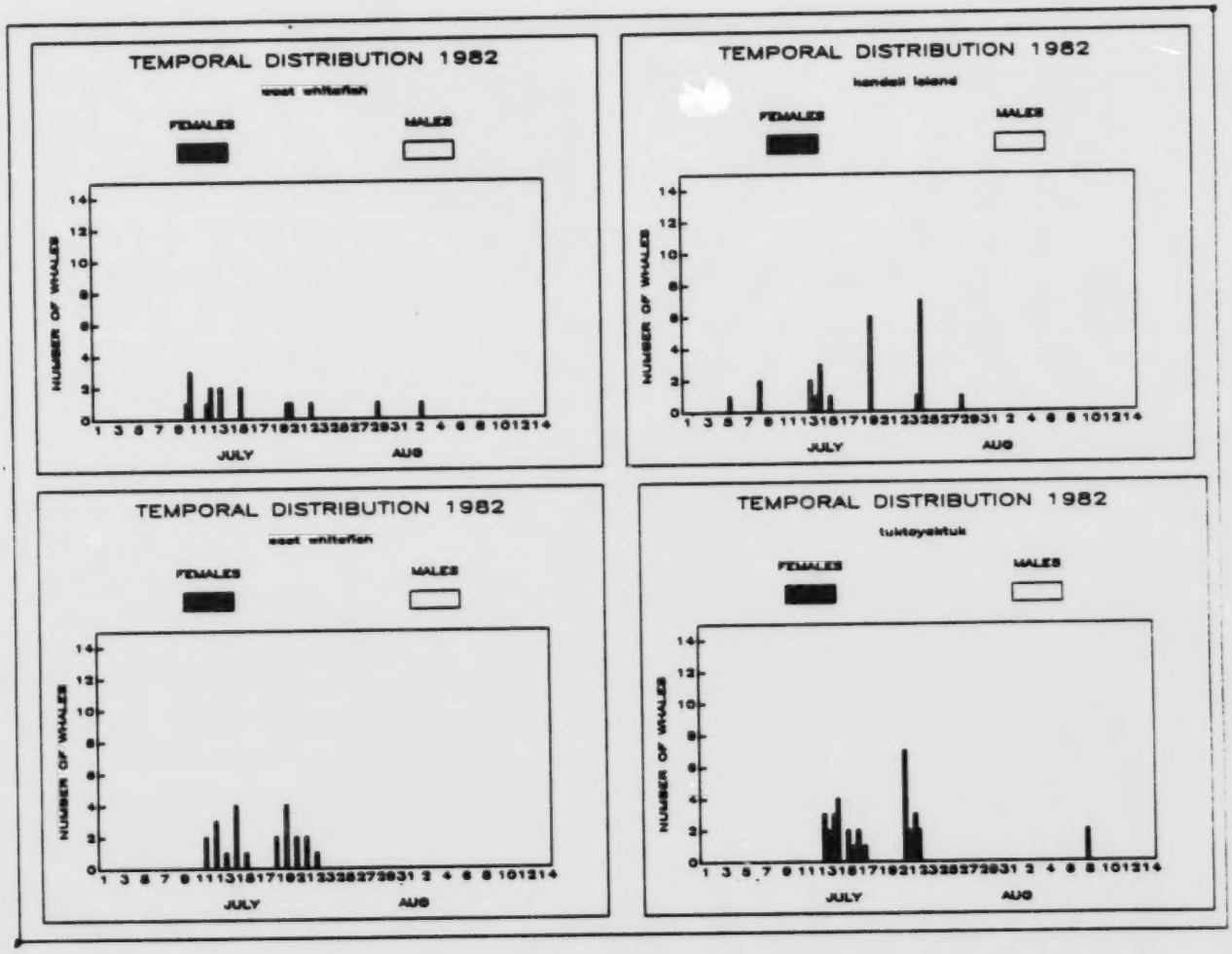
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TEMPORAL DISTRIBUTION 1982
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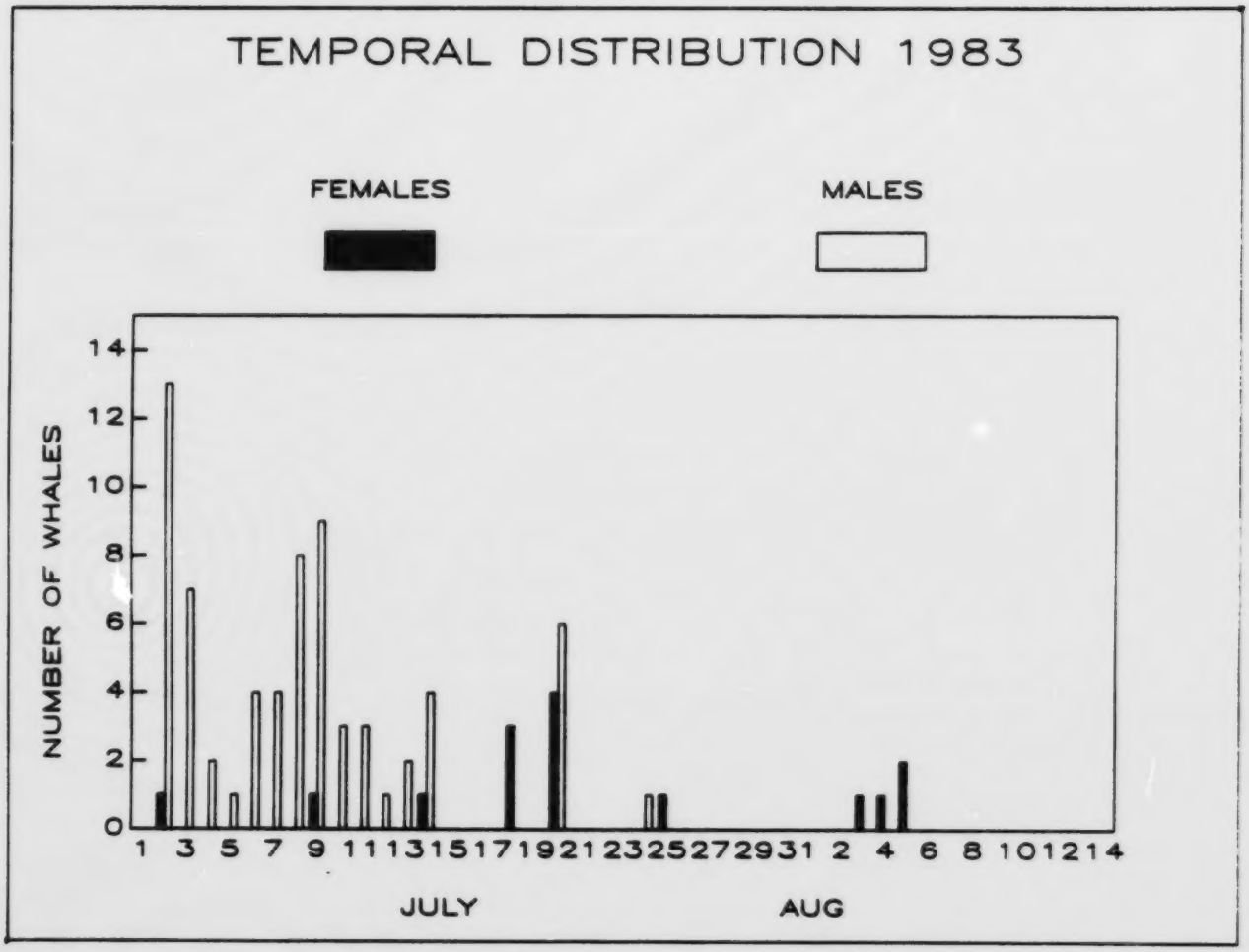
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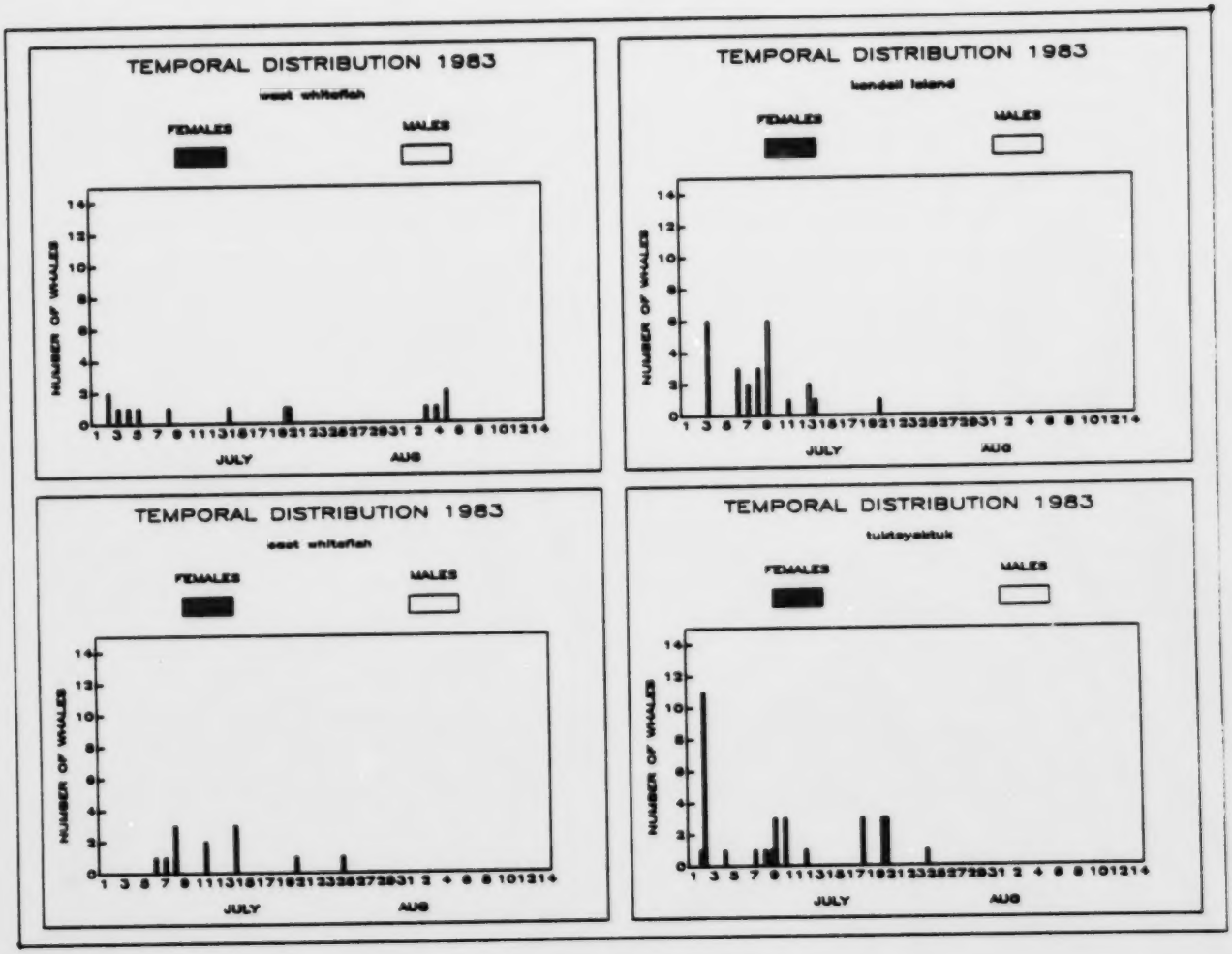
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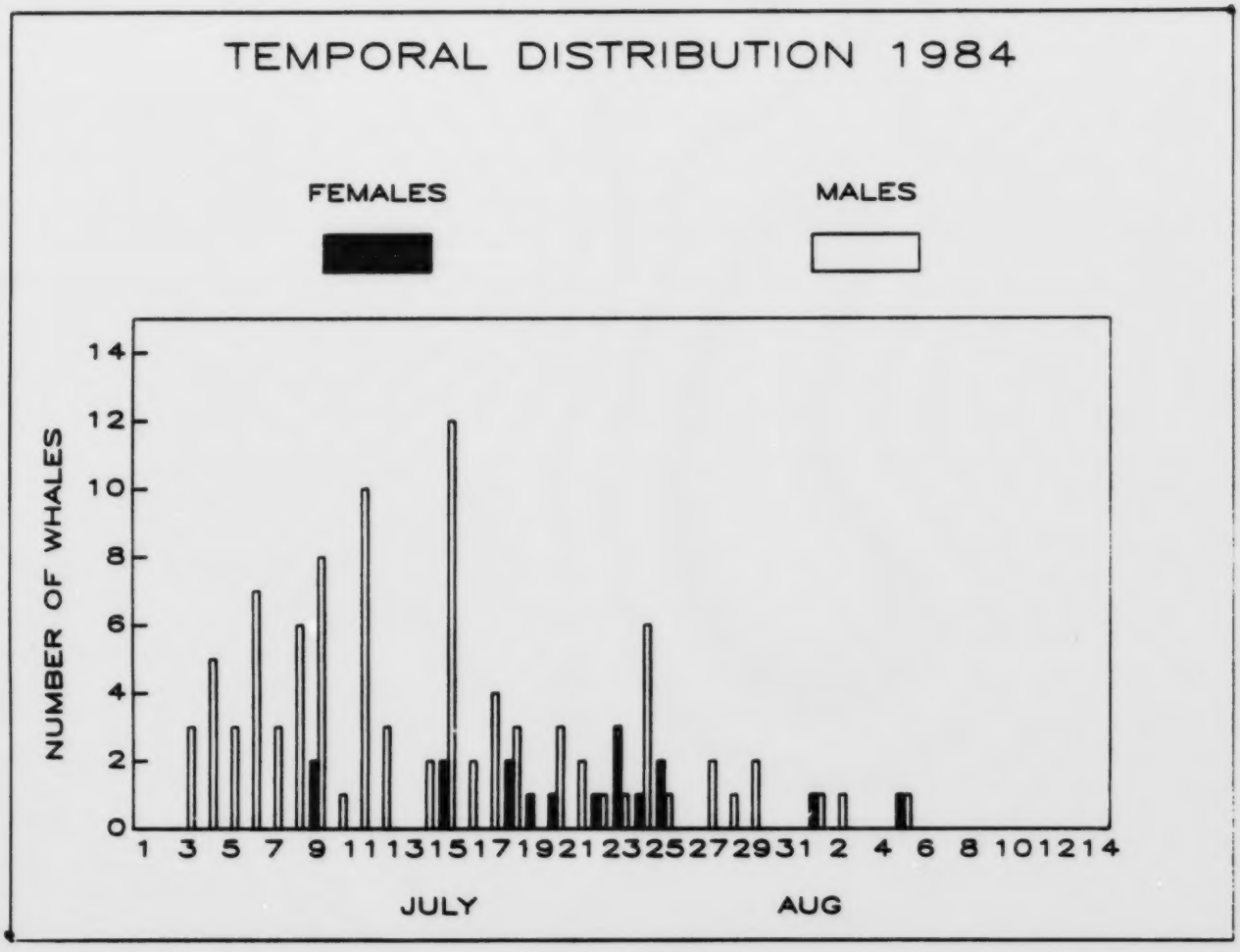
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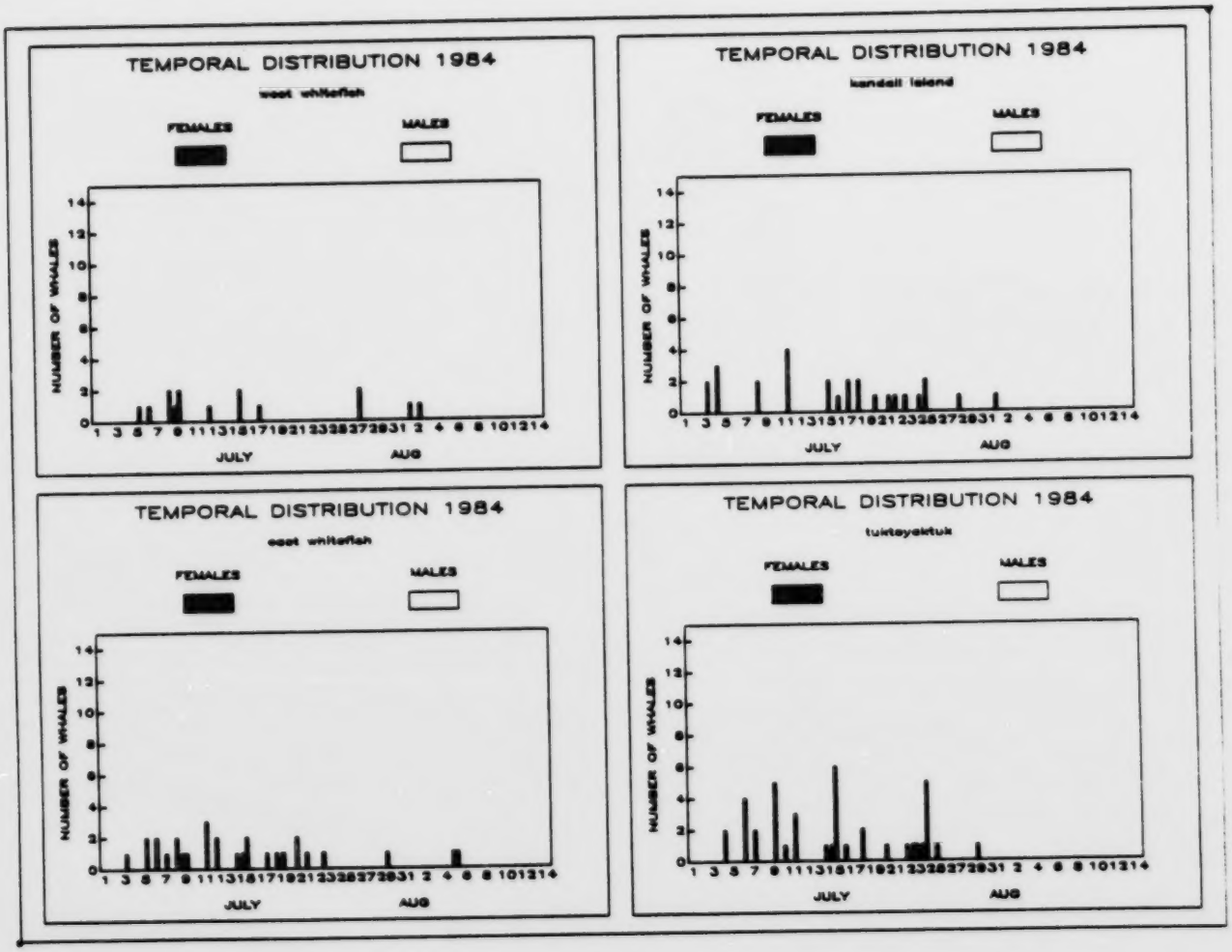
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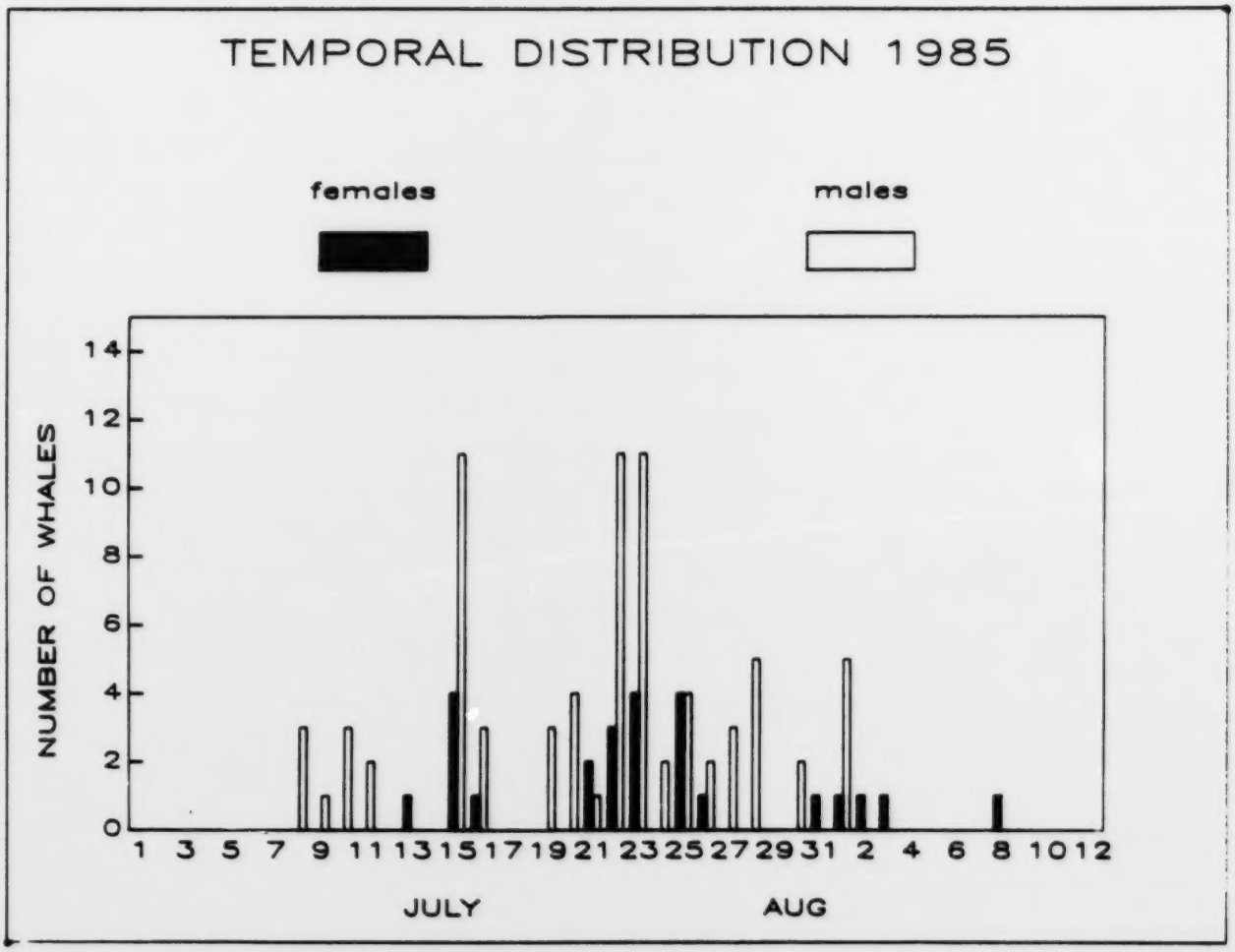
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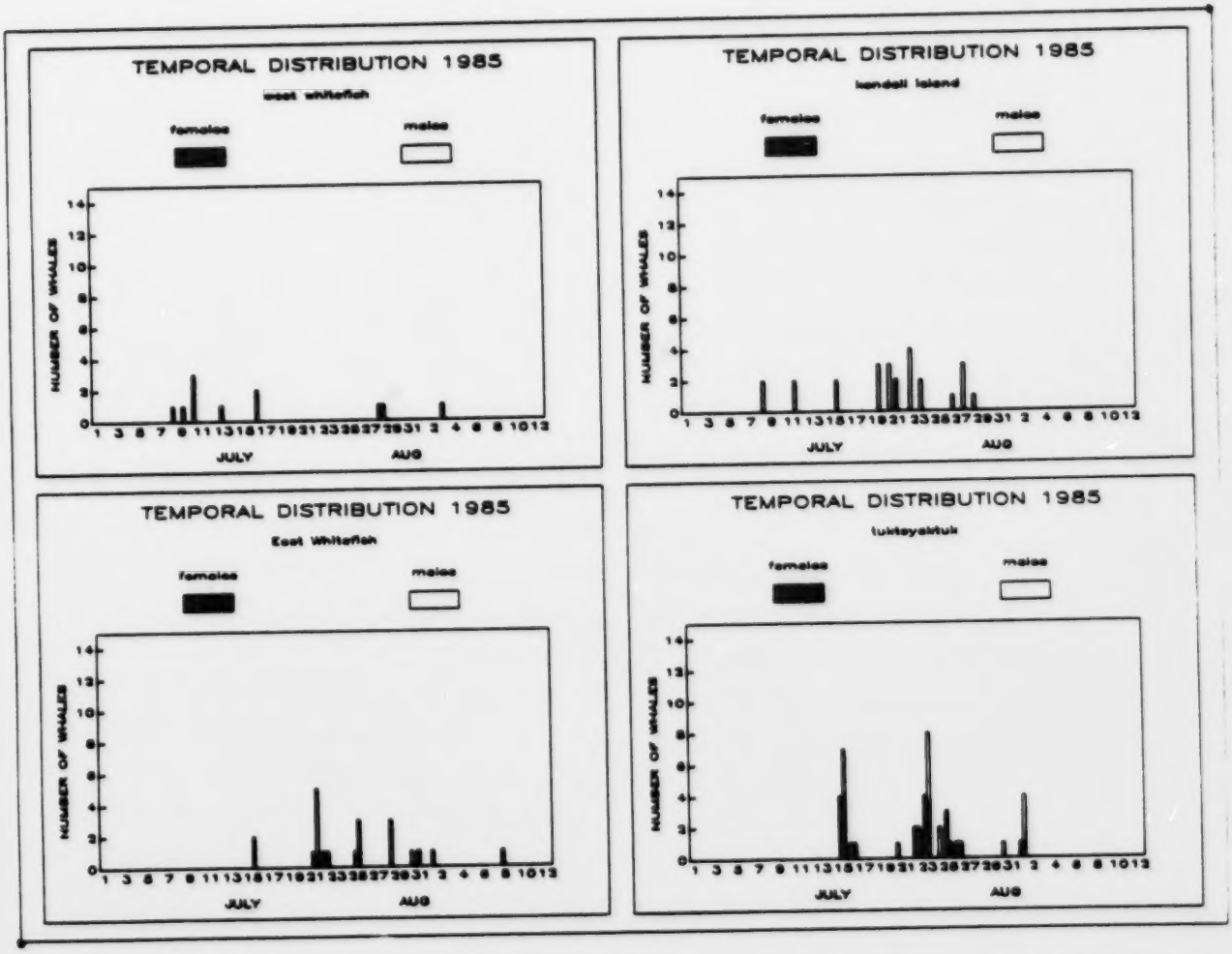
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TEMPORAL DISTRIBUTION 1985
East Whitefish
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NUMBER OF WHALES
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TEMPORAL DISTRIBUTION 1985
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NUMBER OF WHALES
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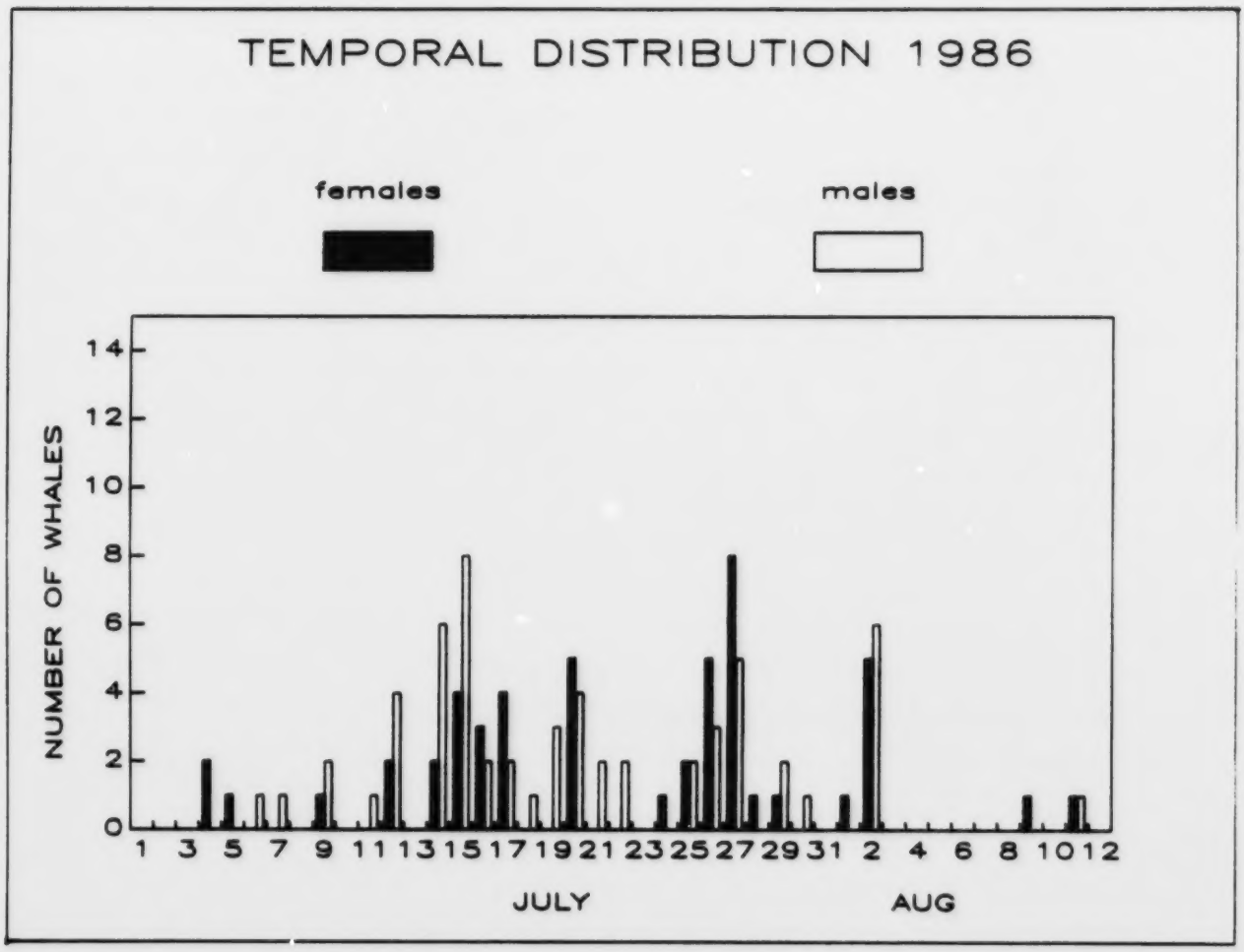
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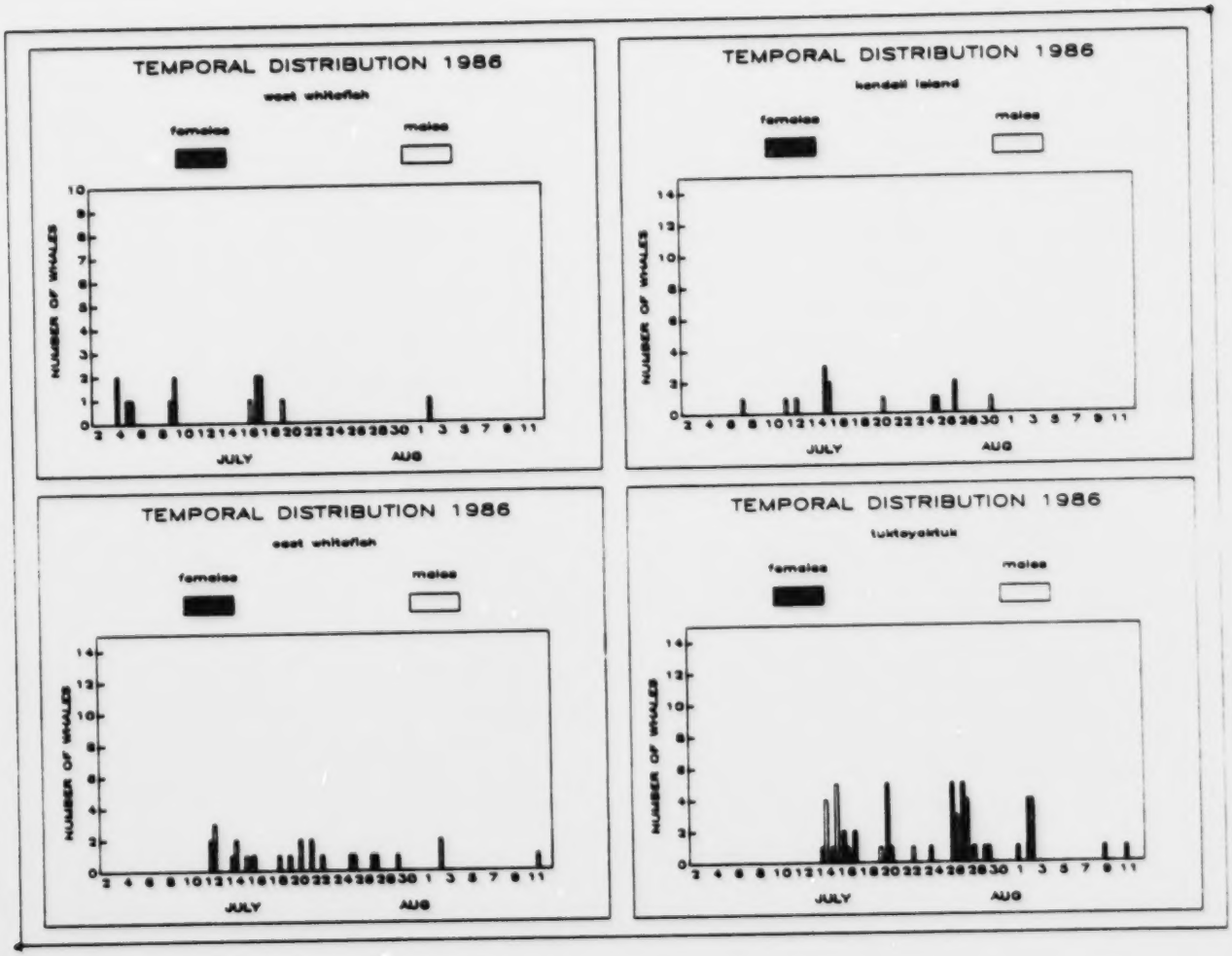
TEMPORAL DISTRIBUTION 1986
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females
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TEMPORAL DISTRIBUTION 1986
west whitefish
females
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NUMBER OF WHALES
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TEMPORAL DISTRIBUTION 1986
tuktoyaktuk
females
males
NUMBER OF WHALES
JULY
AUG

APPENDIX 3

Range, mean and standard deviation of total lengths of beluga from the Mackenzie River Estuary, annually, 1979-1986

Table A3.1. Range, mean and standard deviation of total lengths from the 1979 Mackenzie Delta beluga whale harvest. All lengths in cm.

Location	Sex	n	Range (cm)	Mean	S.D. (cm)
Kendall Island	male	2	360.68-421.64	391.16	43.11
	female	8	345.44-383.54	363.22	11.76
		10			
East Whitefish	male	10	365.76-462.28	423.67	26.61
	female	4	347.98-426.72	377.83	35.52
		14			
Delta Totals	male	12	360.68-462.28	418.25	30.14
	female	12	345.44-426.72	368.09	22.00
		24			

Table A3.2. Range, mean and standard deviation of total lengths from the 1980 Mackenzie Delta beluga whale harvest. All lengths in cm.

Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	9	426.72-548.64	472.72	38.49
	female	5	365.76-457.20	384.05	40.89
	total	14			
Kendall Island	male	14	365.76-500.38	433.61	41.37
	female	7	381.00-434.34	402.05	17.58
	total	21			
East Whitefish	male	2	338.62-472.44	450.53	59.27
	female	9	355.60-447.04	384.95	35.95
	total	11			
Tuktoyaktuk	male	10	411.48-513.08	470.41	32.48
	female	13	320.04-457.20	374.75	41.21
	total	23			
Delta Totals	male	35	365.76-548.64	454.01	
	female	34	335.28-457.20	385.23	
	total	69			

Table A3.3. Range, mean and standard deviation of total lengths from the 1981 Mackenzie Delta beluga whale harvest. All lengths in cm.

Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	13	208.28-548.64	427.94	78.61
	female	7	281.94-378.46	344.90	40.73
Kendall Island	male	6	391.16-464.82	426.30	29.68
	female	15	335.28-406.40	379.81	18.81
East Whitefish	male	8	365.76-487.68	432.75	37.08
	female	16	152.40-419.10	347.19	61.01
Tuktoyaktuk	male	24	248.92-480.06	412.43	41.49
	female	15	312.42-429.26	365.68	34.94
Delta Totals	male	51	208.28-487.68	421.20	51.27
	female	53	152.40-429.26	361.35	43.48

Table A3.4. Range, mean and standard deviation of total lengths from the 1982 Mackenzie Delta beluga whale harvest. All lengths in cm.

Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	13	386.08-480.06	436.32	26.46
	female	3	365.76-449.58	398.78	44.65
Kendall Island	male	23	335.28-469.90	424.44	33.23
	female	2	335.28-365.76	350.52	21.55
East Whitefish	male	20	350.52-505.45	452.31	42.85
	female	0	0	0	0
Tuktoyaktuk	male	14	304.80-487.68	399.14	72.54
	female	21	190.50-449.58	350.40	57.20
Delta Totals	male	70	304.80-505.45	430.34	47.79
	female	28	190.50-449.58	363.71	60.53

Table A3.5. Range, mean and standard deviation of total lengths from the 1983 Mackenzie Delta beluga whale harvest. All lengths in cm.

Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	8	375.92-457.20	419.74	30.74
	female	5	363.22-429.26	388.49	24.46
Kendall Island	male	24	360.68-457.20	436.35	22.19
	female	1	396.24	396.24	0
East Whitefish	male	9	389.89-472.44	421.50	24.70
	female	1	360.68	360.68	0
Tuktoyaktuk	male	21	368.30-468.75	423.73	25.53
	female	7	335.60-372.50	358.06	11.99
Delta Totals	male	62	360.68-472.44	427.78	25.23
	female	14	335.60-429.26	371.84	22.69

Table A3.6. Range, mean and standard deviation of total lengths from the 1984 Mackenzie Delta beluga whale harvest. All lengths in cm.

Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	10	365.76-495.30	442.47	32.43
	female	1	396.24	396.24	0
Kendall Island	male	21	309.88-477.52	430.47	36.60
	female	5	320.04-406.40	361.70	23.94
East Whitefish	male	20	403.86-487.68	425.13	20.76
	female	3	309.88-384.81	355.18	39.18
Tuktoyaktuk	male	35	349.25-477.52	429.93	30.44
	female	5	353.06-441.96	379.48	36.92
Delta Totals	male	86	309.88-495.30	430.40	30.29
	female	14	309.88-441.96	369.12	31.68

Table A3.7. Range, mean and standard deviation of total lengths from the 1985 Mackenzie Delta beluga whale harvest. All lengths in cm.

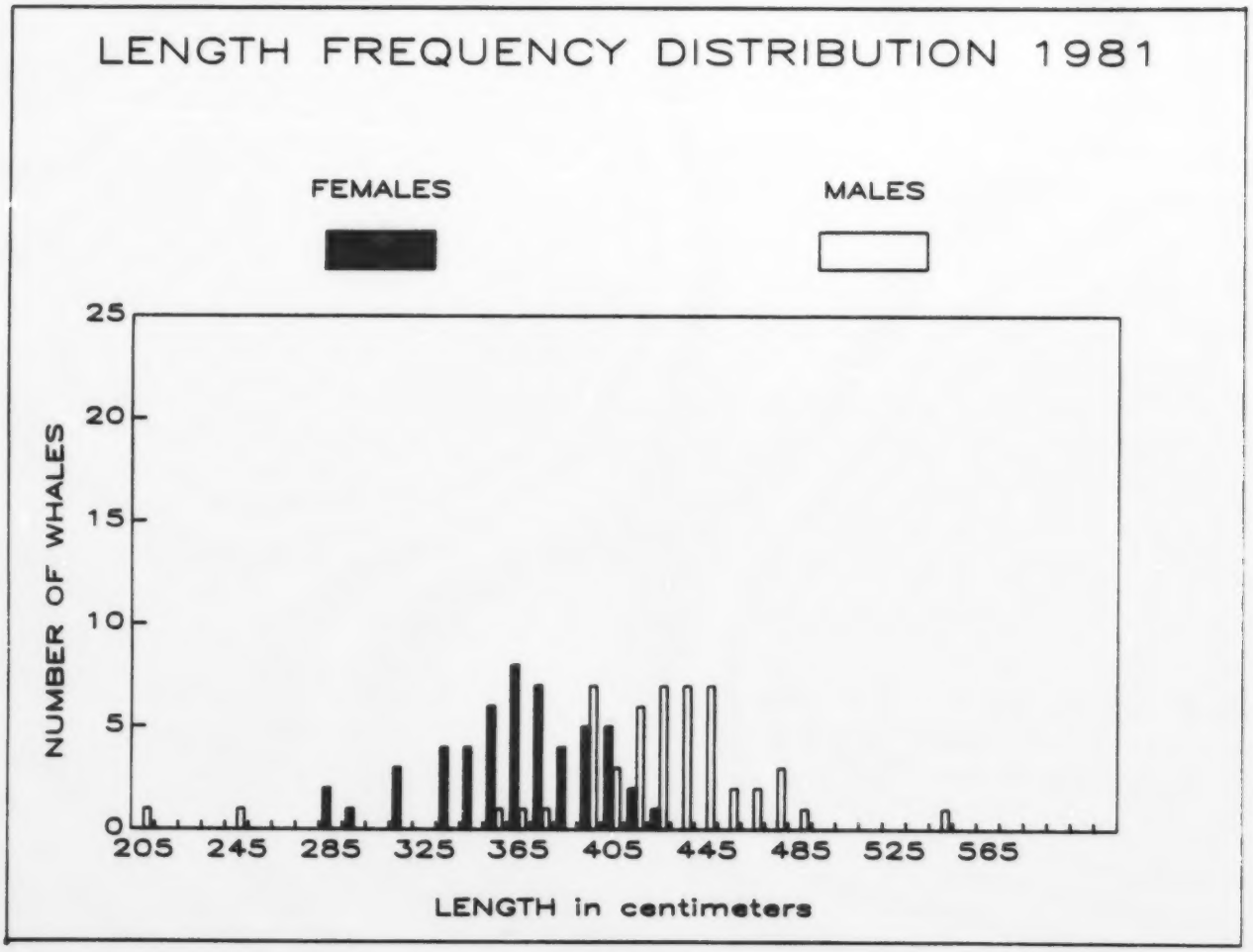
Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	8	388-488	432	34
	female	3	295-366	342	41
Kendall Island	male	23	338-465	431	26
	female	2	376-381	378	4
East Whitefish	male	17	363-465	420	30
	female	5	335-368	367	39
Tuktoyaktuk	male	28	361-513	440	35
	female	16	333-434	374	28
Delta Totals	male	76	338-513	432	31
	female	26	295-434	367	28

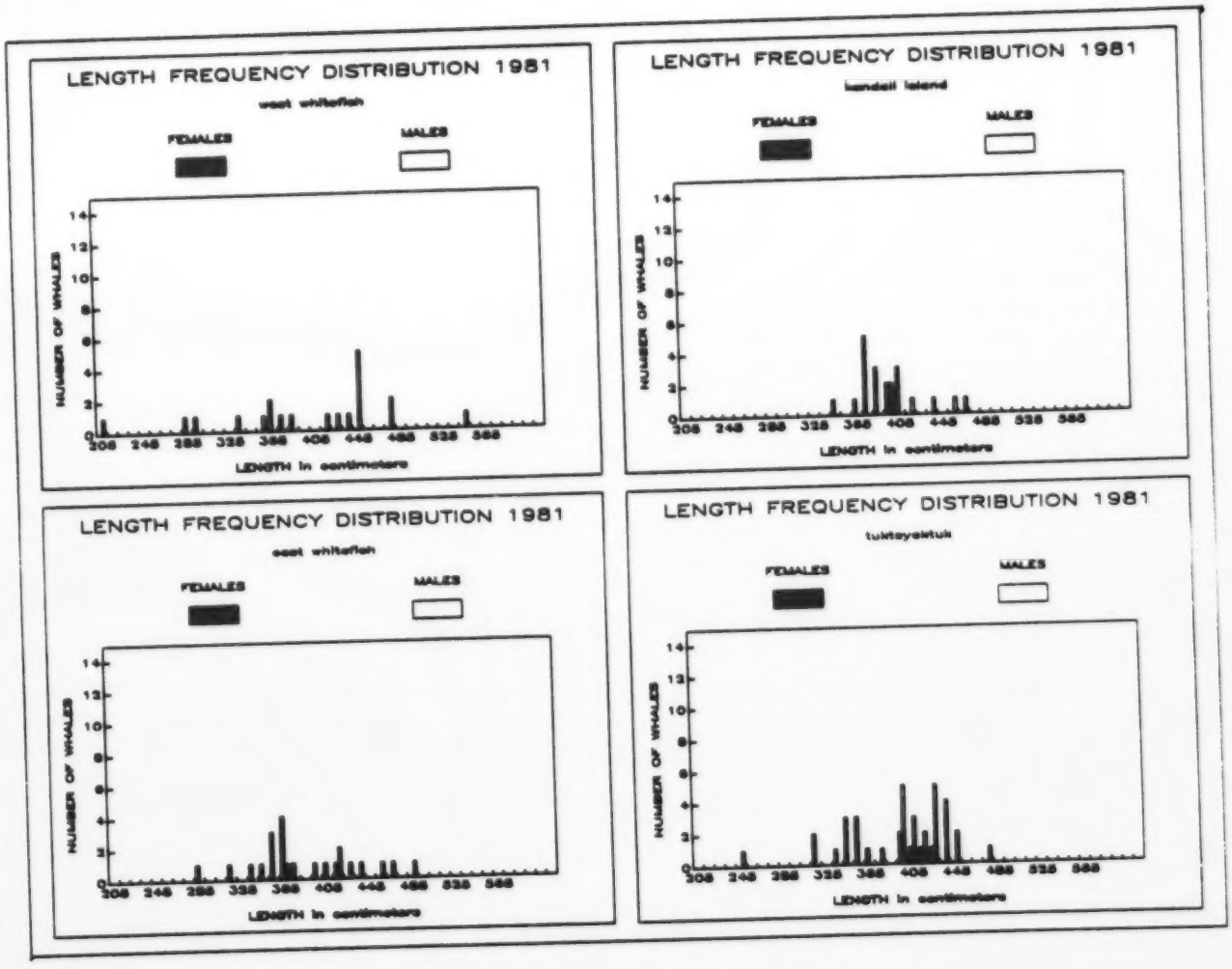
Table A3.8. Range, mean and standard deviation of total lengths from the 1984 Mackenzie Delta beluga whale harvest. All lengths in cm.

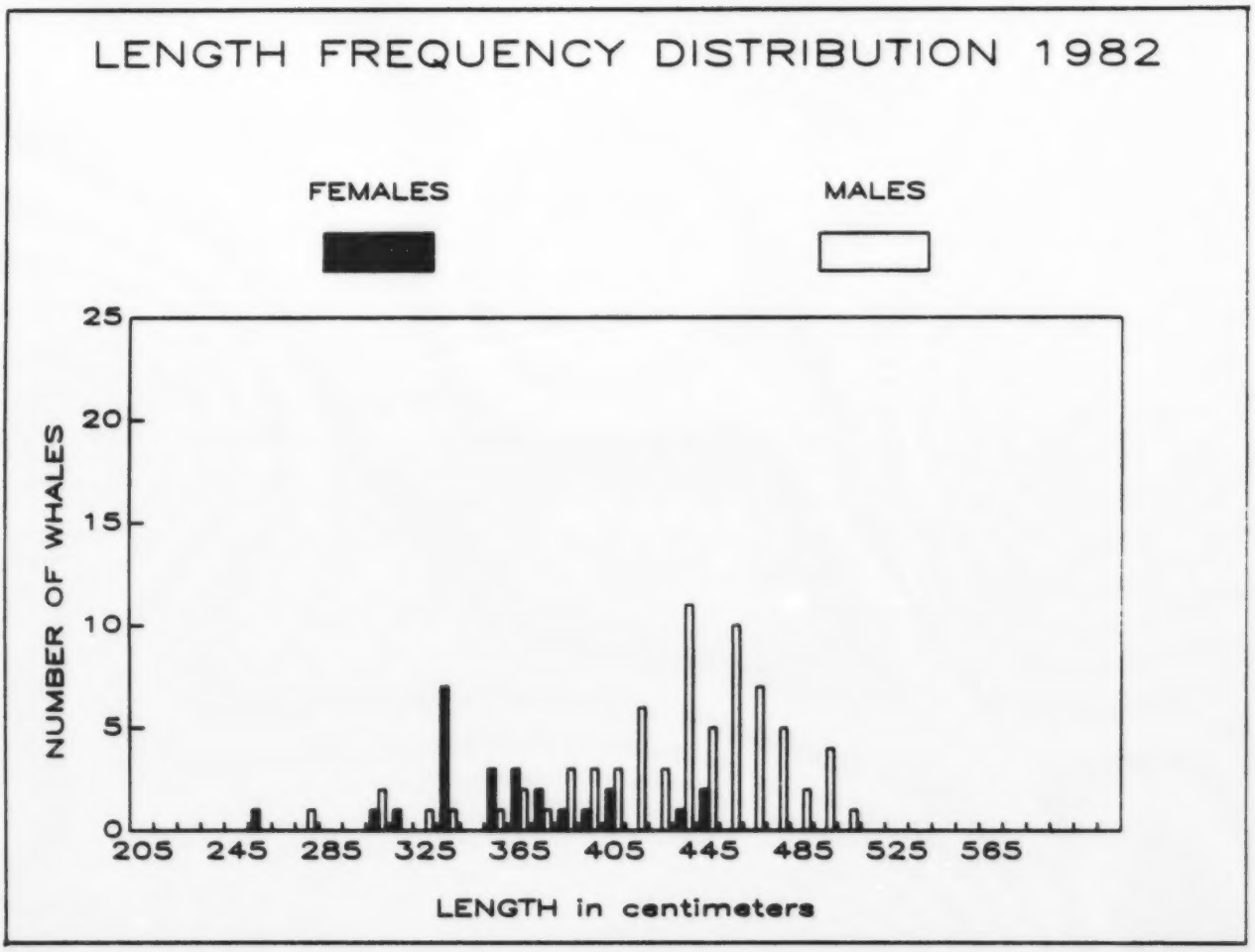
Location	Sex	n	Range (cm)	Mean (cm)	S.D. (cm)
West Whitefish	male	7	396-467	429	27
	female	7	353-432	387	27
Kendall Island	male	8	386-493	427	32
	female	6	366-389	378	9
East Whitefish	male	19	366-448	412	23
	female	6	335-422	372	35
Tuktoyaktuk	male	25	343-470	425	30
	female	31	320-457	378	30
Delta Totals	male	59	343-493	422	28
	female	50	320-457	378	28

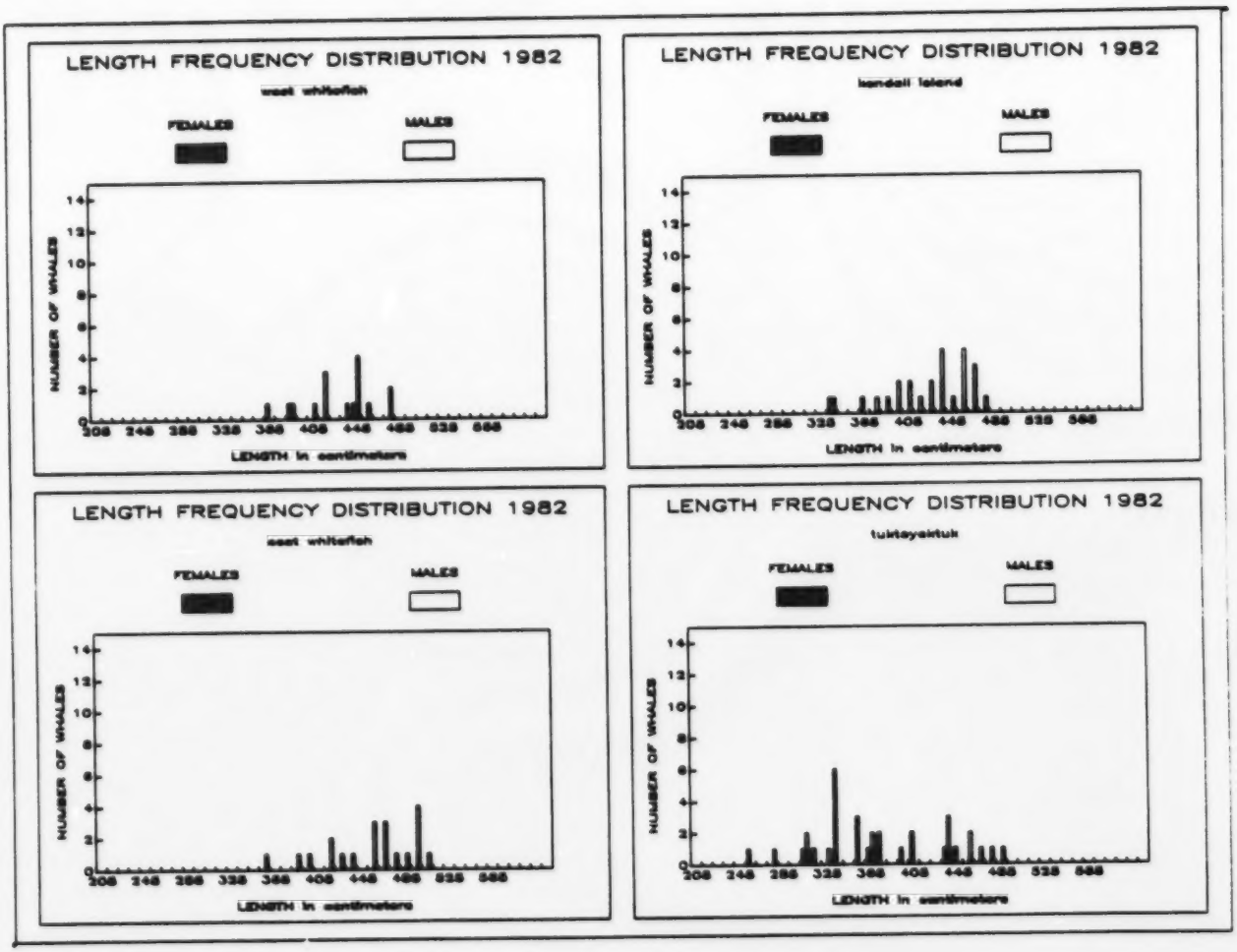
APPENDIX 4

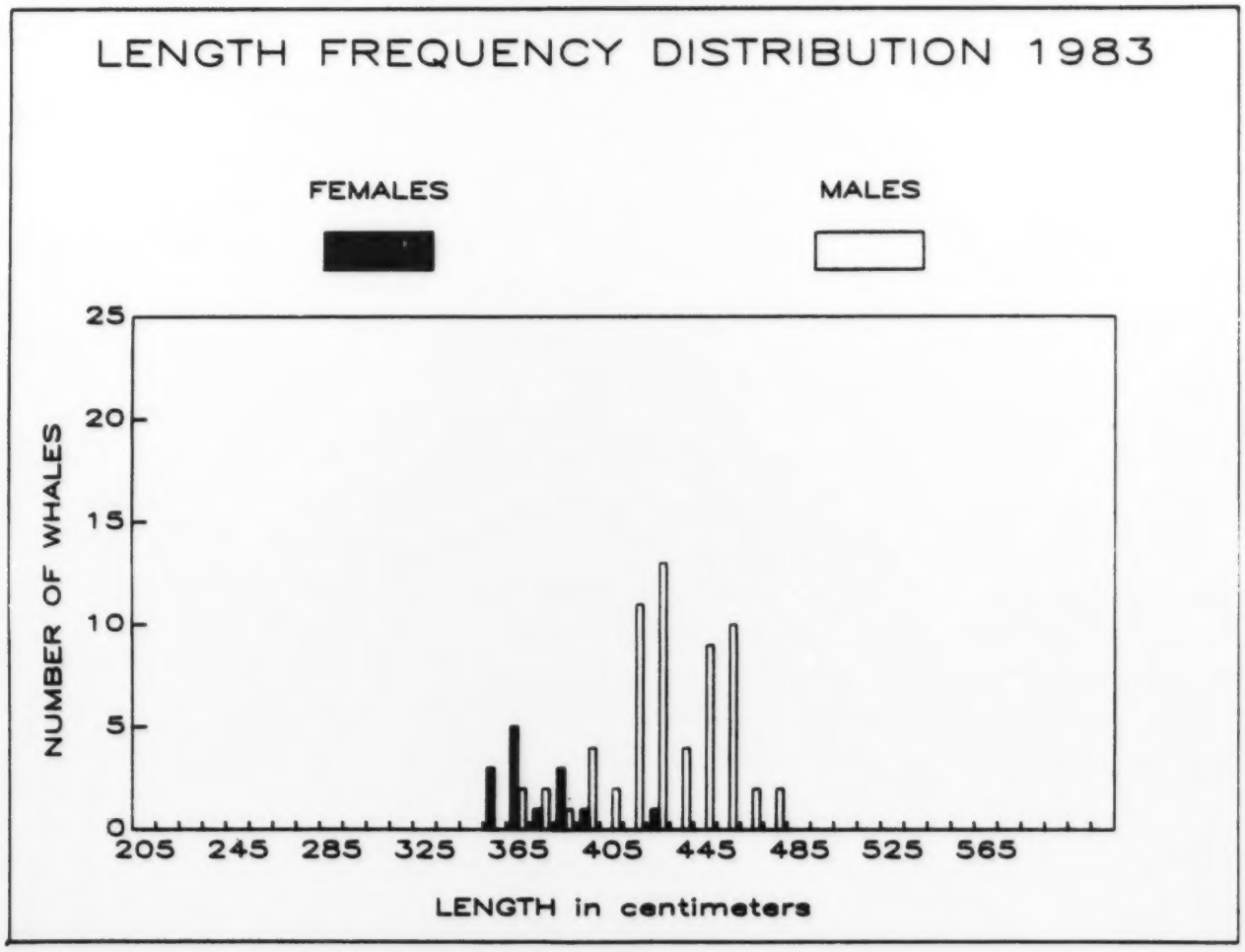
Length frequencies of beluga harvested in the Mackenzie River Estuary: Annually, by area and cumulative, 1981-1985

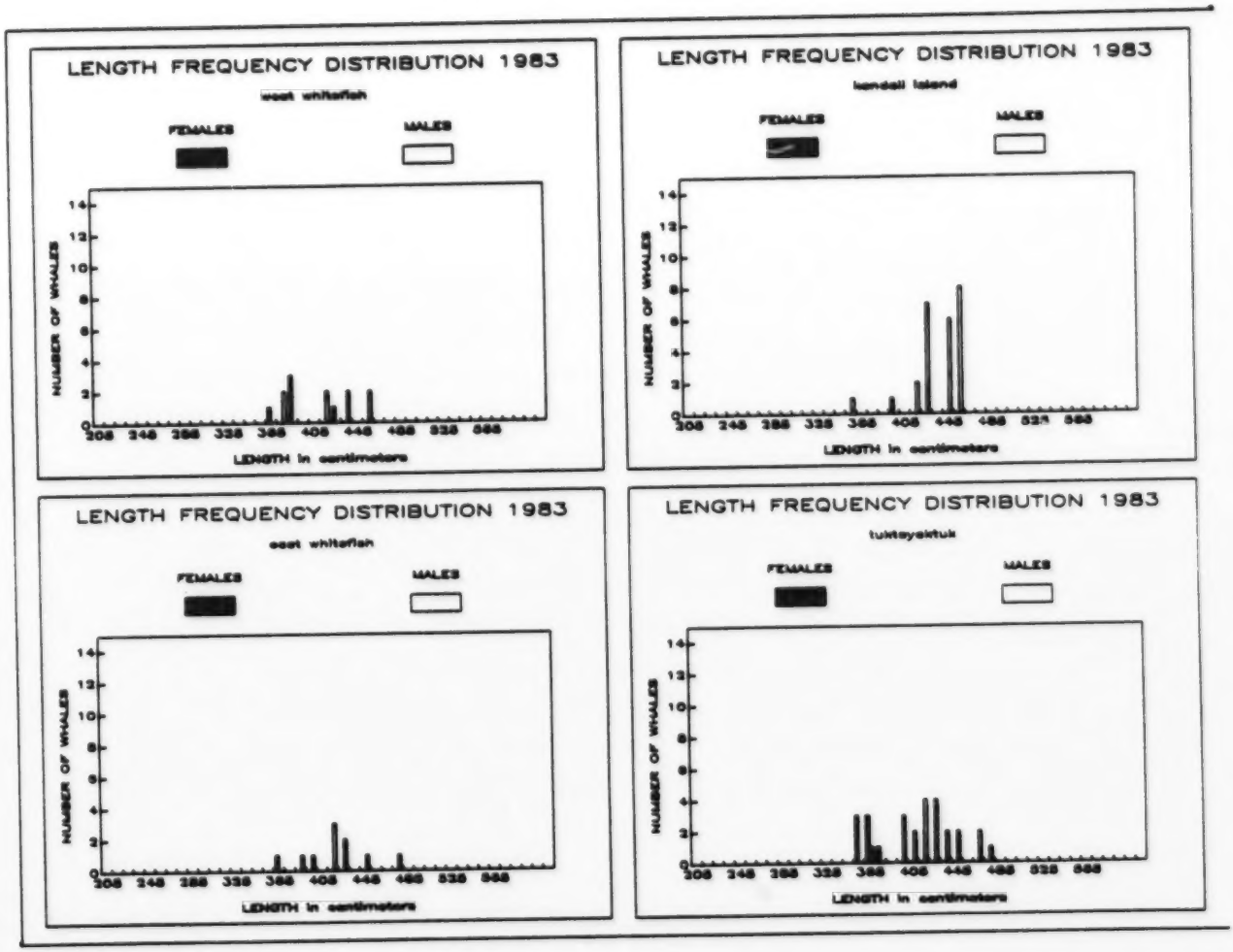

LENGTH FREQUENCY DISTRIBUTION 1981
FEMALES
MALES
NUMBER OF WHALES
25
20
15
10
5
0
205
245
285
325
365
405
445
485
525
565
LENGTH in centimeters

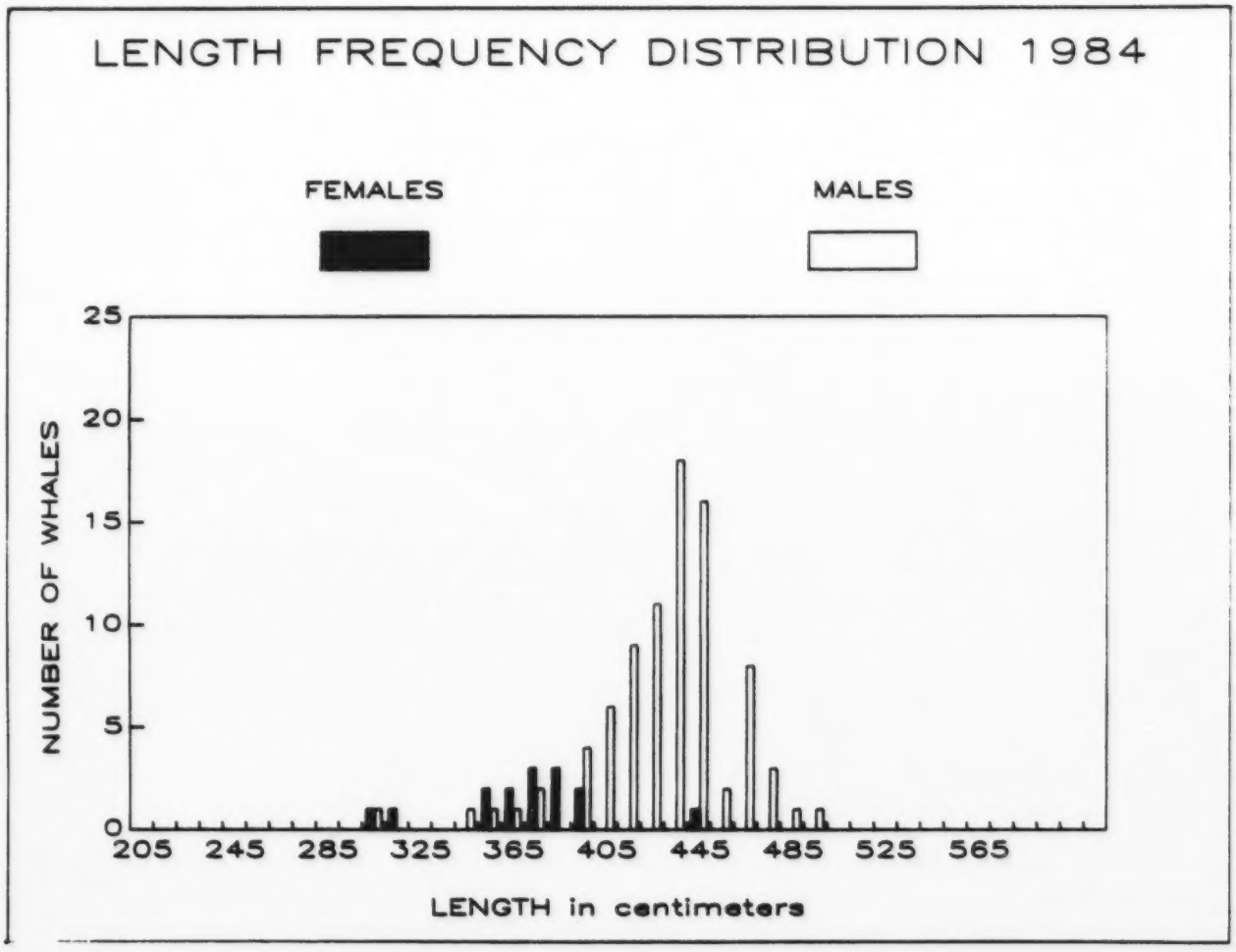

LENGTH FREQUENCY DISTRIBUTION 1981
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1981
Kendall Island
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1981
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1981
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters

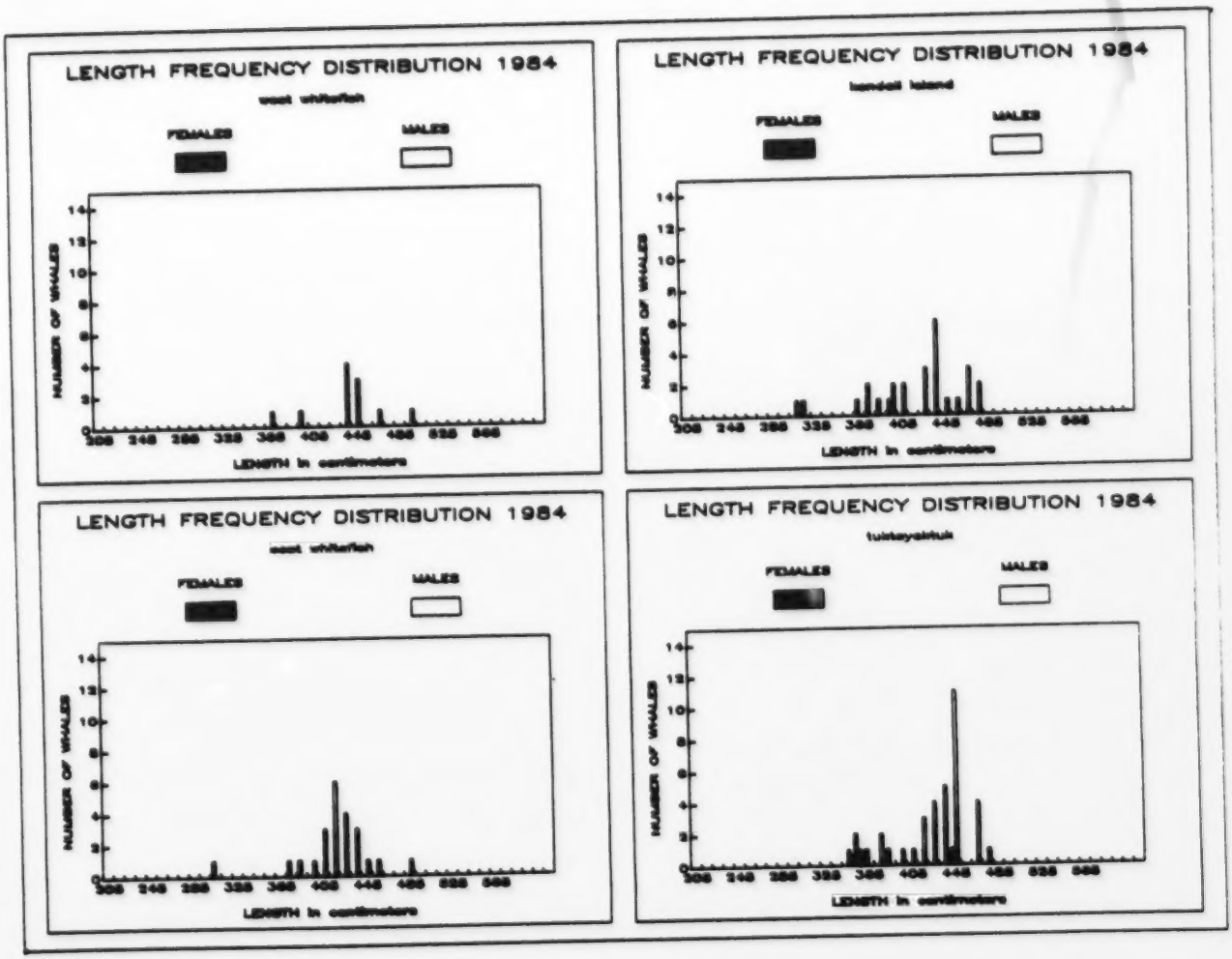

LENGTH FREQUENCY DISTRIBUTION 1982
FEMALES
MALES
NUMBER OF WHALES
0
5
10
15
20
25
205
245
285
325
365
405
445
485
525
565
LENGTH in centimeters

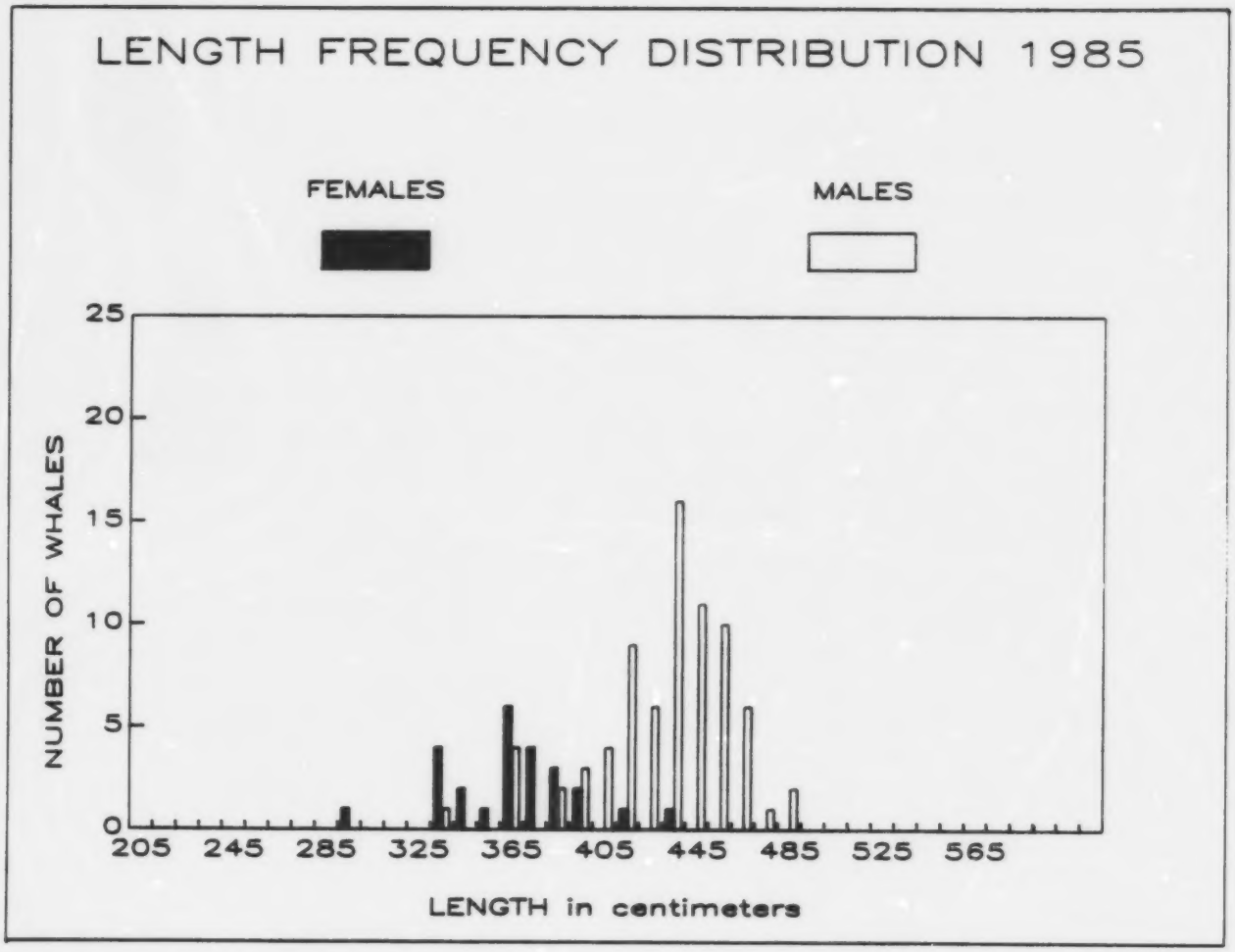

LENGTH FREQUENCY DISTRIBUTION 1982
west whitefish
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1982
kendall island
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1982
east whitefish
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1982
tuktoyaktuk
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters

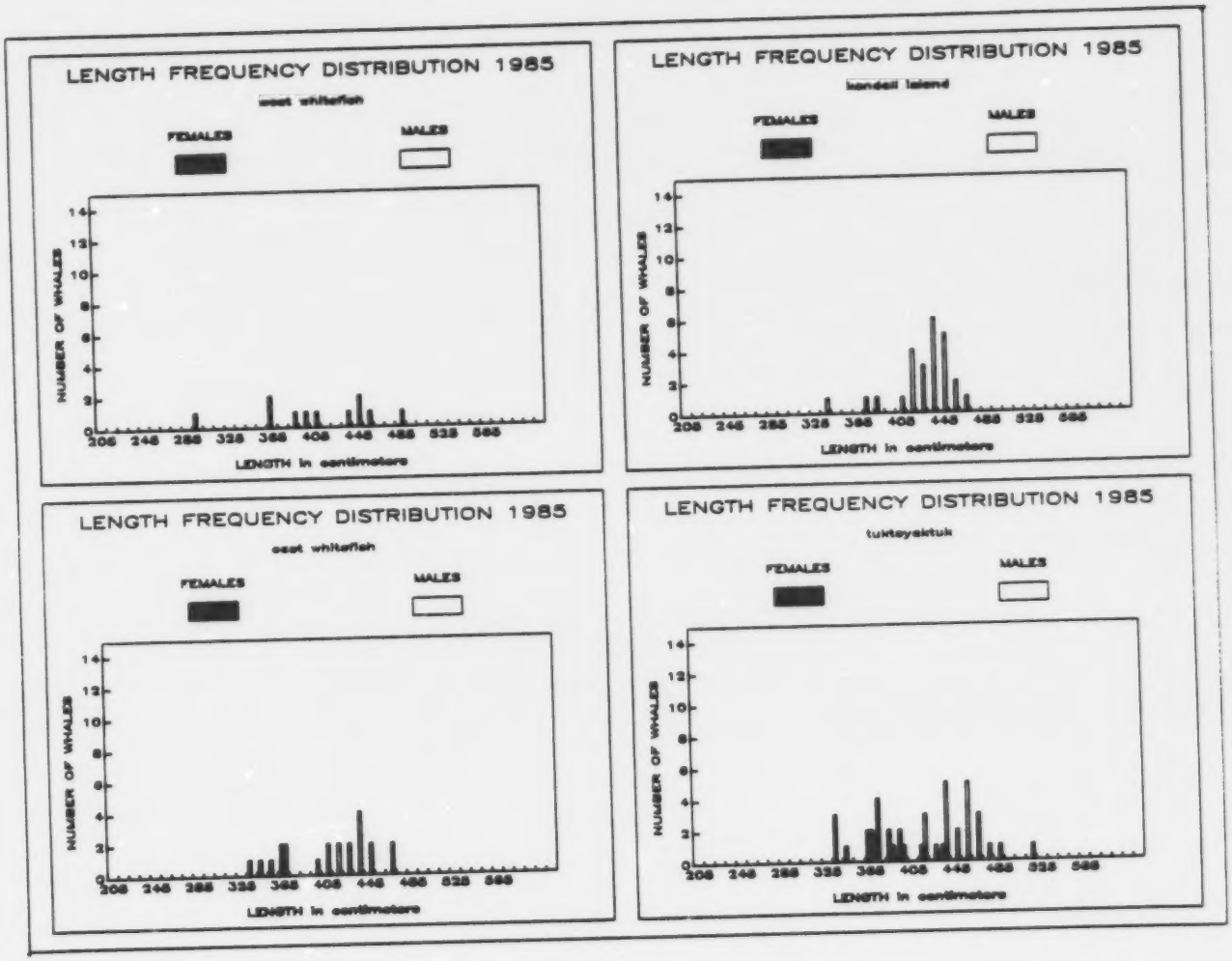

LENGTH FREQUENCY DISTRIBUTION 1983
FEMALES
MALES
NUMBER OF WHALES
0
5
10
15
20
25
205
245
285
325
365
405
445
485
525
565
LENGTH in centimeters

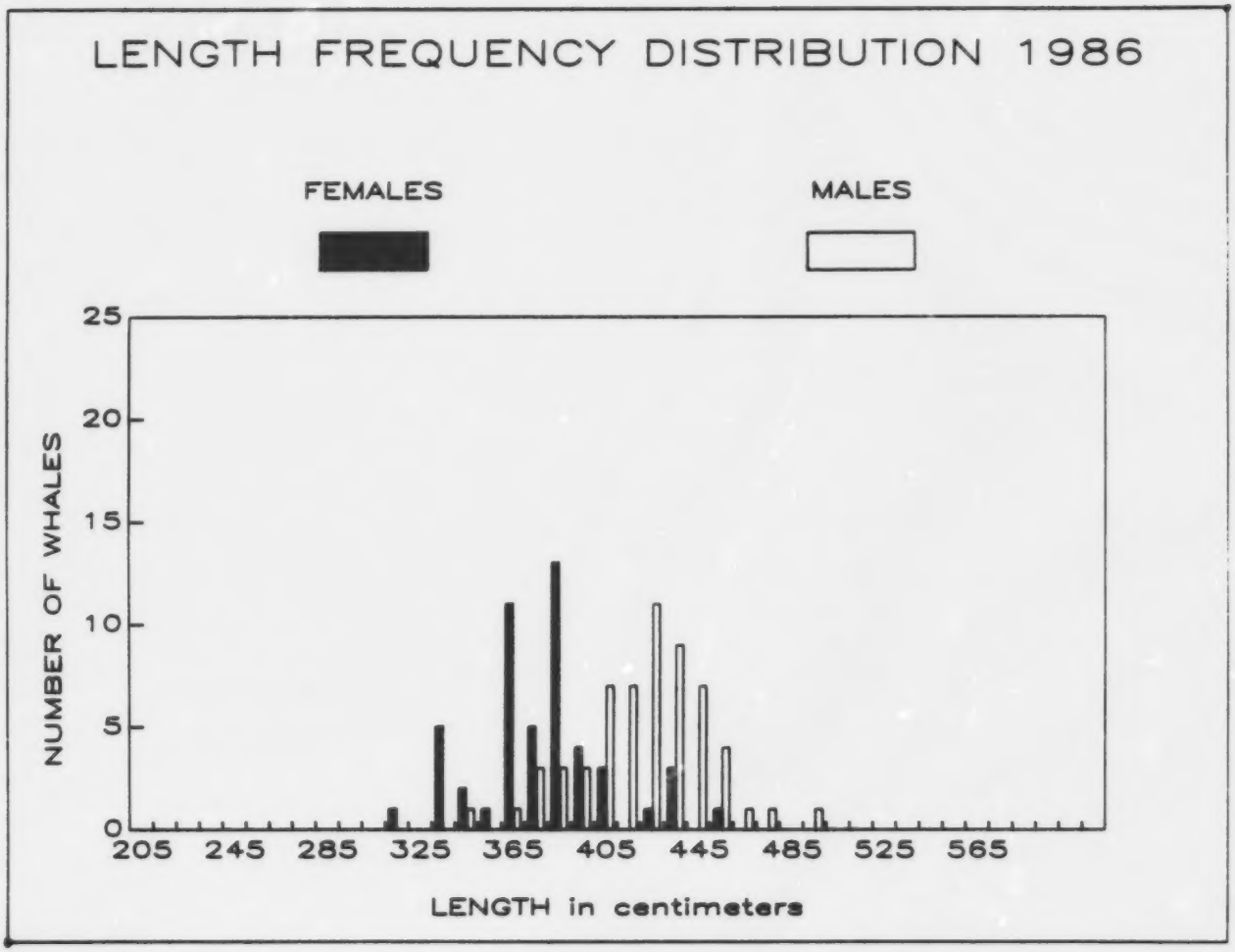

LENGTH FREQUENCY DISTRIBUTION 1983
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1983
kendall island
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1983
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1983
tuktoyaktuk
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters

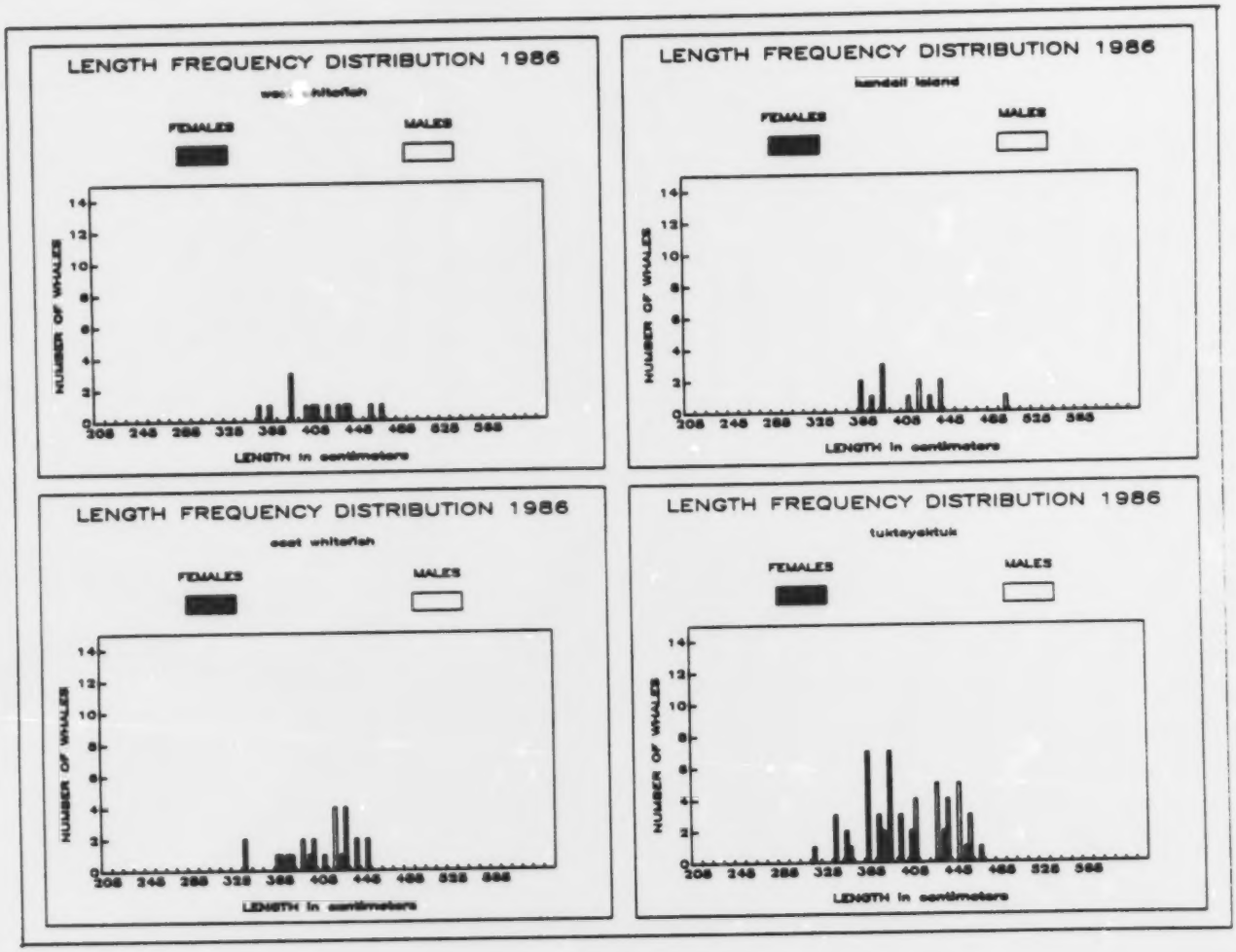

LENGTH FREQUENCY DISTRIBUTION 1984
FEMALES
MALES
NUMBER OF WHALES
0
5
10
15
20
25
205
245
285
325
365
405
445
485
525
565
LENGTH in centimeters


LENGTH FREQUENCY DISTRIBUTION 1984
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1984
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1984
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1984
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters


LENGTH FREQUENCY DISTRIBUTION 1985
FEMALES
MALES
NUMBER OF WHALES
0
5
10
15
20
25
205
245
285
325
365
405
445
485
525
565
LENGTH in centimeters


LENGTH FREQUENCY DISTRIBUTION 1985
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1985
kendeil island
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1985
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1985
tuktoyaktuk
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters


LENGTH FREQUENCY DISTRIBUTION 1986
FEMALES
MALES
NUMBER OF WHALES
0
5
10
15
20
25
205
245
285
325
365
405
445
485
525
565
LENGTH in centimeters


LENGTH FREQUENCY DISTRIBUTION 1986
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1986
kendall island
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1986
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters
LENGTH FREQUENCY DISTRIBUTION 1986
tuktoyaktuk
FEMALES
MALES
NUMBER OF WHALES
LENGTH in centimeters

Appendix 5. Number of teeth recorded from beluga harvested in the Canadian Beaufort Sea.

Whale Length cm	sex	number of teeth	upper			lower		
			right	left	total	right	left	total
335	M	32	8	8	16	8	8	16
349	M	37	10	9	19	9	9	18
389	M	34	9	8	17	9	8	17
396	M	40	10	10	20	10	10	20
403	M	35	9	9	18	8	9	17
410	M	35	8	9	17	9	9	18
410	M	28	6	7	13	8	7	15
411	M	27	7	7	14	7	6	13
411	M	28	8	8	16	6	6	12
414	M	34	9	9	18	8	8	16
414	M	38	10	10	20	9	9	18
415	M	36	9	9	18	9	9	18
417	M	28	7	7	14	7	7	14
421	M	36	9	9	18	9	9	18
422	M	35			18			17
426	M	38	11	9	20	9	9	18
426	M	34	9	9	18	8	8	16
429	M	31	8	8	16	7	8	15
430	M	33	8	8	16	8	9	17
435	M	39	10	11	21	9	9	18
457	M	32			18			14
472	M	37	10	10	20	9	8	17
477	M	38	11	9	20	9	8	17
327	F	31	6	7	13	9	9	18
360	F	39	10	10	20	10	9	19
411	F	32	9	9	18	7	7	14
?	F	30	8	8	16	7	7	14